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CHECKING THE NET CONTENTS OF PACKAGED GOODS

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The National Bureau of Standards[1] was established by an act of Congress on March 3, 1901. The Bureau's overall goal is to strengthen and advance the nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau's technical work is performed by the National Measurement Laboratory, the National Engineering Laboratory, the Institute for Computer Sciences and Technology, and the Center for Materials Science.

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[1] Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Gaithersburg, MD 20899.

[2] Some divisions within the center are located at Boulder, CO 80303.

[3] Located at Boulder, CO, with some elements at Gaithersburg, MD.

NBS HANDBOOK 133 - SECOND EDITION
CHECKING THE NET CONTENTS OF PACKAGED GOODS

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PURPOSE

This handbook has been prepared as a procedural guide for compliance testing of net contents statements on packaged goods. Compliance testing of packaged goods is the determination of the conformance of the results of the packaging, distribution, and retailing process (the packages) with specified legal requirements for net contents declarations. Although the handbook has been developed primarily for use by weights and measures officials of the States, counties, and cities, it also should be useful to commercial and industrial establishments involved in the packaging, distribution, and sale of commodities.

SCOPE

In 1959, the National Bureau of Standards published Handbook 67, "Checking Prepackaged Commodities", also a guide for compliance testing the net contents of packages. This handbook differs from NBS Handbook 67 in two significant areas:

1. Two categories of sampling plans are presented for packages subject to the average requirement.
   - The sampling plans in Handbook 67 have been modified and appear as "Category B" sampling plans in Handbook 133.
   - A new set of sampling plans ("Category A") have been introduced.
2. Comprehensive test procedures are provided in detail for a wide variety of commodities. Handbook 67 described tests on packages labeled by weight and by volume only.

This handbook provides procedures using statistical sampling techniques to test individual lots of packages for conformance with legal requirements. Anything that is put into a container, wrapped, or banded, and labeled as to quantity may be inspected.

The labeled quantity may be of: weight; volume; linear, square, or cubic measure; count; or combinations thereof. Packaged commodities may be examined to determine conformance with Federal, State, or local net contents labeling regulations. Compliance testing of packaged goods is generally directed toward protecting the consumer/purchaser from receiving packages with less than the labeled quantity of contents and to advise the manufacturer when improvements in delivered product quantities are necessary. Tests for health and safety may require different sampling and test measurements.

Inspection for compliance with other labeling requirements (such as size of lettering or units of measurement) may also accompany package quantity compliance testing, but is not covered in this document.

INTRODUCTION TO THE SECOND EDITION

Based on experience gained by conducting numerous package testing workshops around the country since the first edition was published, the authors made significant improvements in report forms and in the arrangement of the tables. In 1983, comments on the first edition were requested of government officials and industry and business representatives in anticipation of publishing a second edition. The comments were compiled and used as a further basis for changes to the first edition.

Major differences between the 1981 edition and the present one are:

- Category A and Category B sampling plans are compared graphically in the second edition. There is no general linkage between the categories of plans and types of enforcement action.
- The number of sampling plans in Category A have been reduced.
- The recommendation that wet tare be used wherever possible has been dropped. Whatever tare is available is acceptable.
- The Maximum Allowable Variations (MAV's)[1] for packages with labeled weights less than 1.28 oz and more than 54.40 lb have been changed.
- The MAV's for packages with labeled lengths less than one yard have been changed.
- A test method for bark mulch has been added.
- Significant changes have been made to improve the report forms and worksheets.
- The decision charts have been eliminated.
- The most-used procedure has been designated as a "CORE METHOD" and other procedures build on it.
- Greater detail has been added to the random-pack package and milk testing procedures.
- All tables and forms have been placed in separate sections for ease of reference.

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[1] See page 1-2 for definition and Section 2.12. for magnitudes.

HOW TO USE THIS HANDBOOK

This manual contains information on equipment, test methods, calculations, and test reporting. The handbook is divided into five chapters. The first chapter covers several introductory items directed primarily to the administrator of a package testing program. The remainder (Chapters 2 through 5 and the appendices) is intended as a handbook for the field testing official.

The second chapter discusses fundamentals and general sampling procedures. The testing official should study this chapter thoroughly before attempting to follow the test procedures given in the rest of the handbook.

The third, fourth, and fifth chapters detail the test methods. Chapter 3 covers packages labeled by weight; Chapter 4 covers packages labeled by volume; and, Chapter 5 covers other package quantities. These three chapters provide the test methods for checking different types of packages.

Appendix A contains report forms and worksheets for field test use. Appendix B contains all the tables that are referred to in Chapters 1 through 5 of the handbook. The testing official should tab these tables for quick reference in the field. Appendix C is a glossary of terms that are used throughout the handbook. Appendix D contains a compilation of pertinent parts of net contents regulations at the Federal level and those recommended by the National Conference on Weights and Measures for State adoption. Appendix E contains descriptions of how to select a random sample. This section, like Chapter 2, should be studied by the testing official prior to following the test procedures in Chapters 3, 4, and 5. Appendix F and G are random number tables, and should also be tabbed for easy reference. Appendix I lists equipment tolerances for field test weights and flasks. Appendix J is an excerpt from the USDA Meat and Poultry Inspector's Manual. At the end of the handbook is an index which will be valuable for directing the official to the appropriate test method for specific commodities.

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CHAPTER 1. INTRODUCTION

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CHAPTER 1. INTRODUCTION

This chapter provides background information on package regulations, regulatory and enforcement agencies in the United States, and package testing programs. The concept of checking packaged goods by sampling is introduced. Other terms that are routine to package inspection are also discussed in the context of this handbook, such as the average requirement, audit testing, and moisture allowance.

1.1. REGULATORY AGENCIES

In the United States, several regulatory agencies have authority in packaged product labeling. At the national level, the U.S. Department of Agriculture promulgates requirements for packaged goods containing meat or poultry, as part of the department's responsibility under the Federal Meat Inspection Act as amended by the Wholesome Meat Act and the Poultry Products Inspection Act as amended by the Wholesome Poultry Products Act. The Food and Drug Administration under the U.S. Department of Health and Human Services promulgates requirements for packages containing all other food products and all drug and cosmetic products and medical devices as part of this agency's responsibility under the Food, Drug, and Cosmetic Act and the Fair Packaging and Labeling Act (FPLA). The Federal Trade Commission promulgates requirements for many nonfood consumer-sized packaged products as part of the agency's responsibility under the FPLA.

The Environmental Protection Agency promulgates requirements for packaged pesticides as part of the agency's responsibility under the Federal Insecticide, Fungicide and Rodenticide Act. The Bureau of Alcohol, Tobacco, and Firearms in the U.S. Department of the Treasury promulgates regulations for packaged tobacco and alcoholic beverages as part of its responsibility under the Federal Alcohol Administration Act.

Packaged goods produced for distribution for sale also come under the jurisdiction of State and local weights and measures agencies, which have their own legal requirements for packaged goods.

Those parts of the pertinent Federal and State regulations are listed in Appendix D.

Federal statutes set requirements that affect State regulations. Therefore, State agencies using this handbook should keep abreast of the revisions to Federal agency regulations that may contain sampling or testing information not in the regulations at the time of publication of this handbook.

1.2. PACKAGE REQUIREMENTS

1.2.1. The Average Requirement

Although net-contents regulations often differ in wording, a uniform operational interpretation has traditionally been applied for the purpose of testing the net contents of packages for compliance with these regulations. There are two requirements that the quantity of contents of packaged goods must meet. First, the average quantity of contents of packages in a lot, shipment, or delivery must equal or exceed the quantity printed on the label. The second requirement applies to the individual package: the variation of individual package contents from the labeled quantity must not be "unreasonably large". Both requirements apply simultaneously to any given collection of packages, and this handbook provides methods to test packages against them. Limits of "reasonable variation" for individual packages are listed in tables of "MAV"[1] (See Section 2.12. and pages B-9 through B-15.)

In common parlance, these two requirements that the package net contents must meet are called "the average requirement" (even though there are two requirements).

1.2.2. An Exception

The National Conference on Weights and Measures (NCWM), an organization of State and local weights and measures officials, has adopted standards, called "uniform laws and regulations", upon which individual jurisdictions may model their laws and regulations. Several States have adopted that portion of the NCWM Uniform Regulation for the Method of Sale of Commodities[2] which provides a tolerance for pressed and blown glass tumblers and stemware. In this regulation, such a tolerance is called an "allowable difference". When packaged product quantities are given tolerances, the average and individual package requirements described above do not apply. This handbook provides procedures for testing glassware in Section 5.7.

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[1] The acronym "MAV" is from the term "maximum allowable variation". The meaning of the term derives from the regulations that permit no unreasonable variations.

[2] This regulation is part of National Bureau of Standards (NBS) Handbook 130, "Uniform Laws and Regulations" as adopted by the National Conference on Weights and Measures, revised and printed each year by the U.S. Government Printing Office.

1.3. THE PACKAGE TESTING PROGRAM

For the benefit of the regulatory agency program administrator, several items are discussed in this section concerning the establishment of a broad and diversified package testing program.

1.3.1. Where to Test

Package commodities may be tested in any location from packaging plant to retail outlet.

Point of Pack

Checking packages at the location where they are packaged ("point of pack") has the greatest impact on the packaging process. The official can sample from the largest number of packages of a single product available at one place, and the manufacturer can immediately correct any problems found before packages are distributed. Small economies are obtainable if the packager can recover and repackage the product from packages that must be opened for testing purposes.

When the product is packaged at the retail store (the supermarket meat counter being the classic example), package inspection at retail is equivalent to inspection at the point of pack.

Package testing at production point cannot entirely replace that at wholesale or retail outlets. Since only manufacturing practices can be examined at production point, testing of packages at wholesale and retail outlets must also be part of a complete package inspection program. The results of distribution practices, possible tampering with the product, and environmental effects can only be detected by wholesale and retail checking. Thus, inspection resources should be divided, if possible, between testing at the packaging location and testing at wholesale and retail locations.

The effectiveness of package testing programs conducted by individual State and local agencies would be maximized if these agencies established reciprocity with other State, county, and city jurisdictions to recognize results of tests carried out by other agencies at packaging plants.

Wholesale

When possible, warehouse-outlet package testing is a good alternative to testing at the production point with respect to testing large amounts of product. There is a severe drawback to checking at wholesale, however, namely getting to the stacks of pallets, breaking down film-wrapped or wired skids, and opening sealed cartons. Labor costs, equipment, and time requirements, including the time needed to restack skids and pallets, can be excessive. Because of the importance of wholesale testing to the follow-up of inaccuracies discovered during retail checking, guidelines are given in Appendix E to simplify selection of the package sample at wholesale outlets.

Retail

Package testing at retail checks the soundness of the manufacturing, distribution, and retailing processes of the widest variety of goods available at a single location.

Package testing at retail locations checks the accuracy of the package label at the locations where consumers purchase the product. It is an excellent means for State and local jurisdictions to monitor packaging procedures and to detect present or potential problems.

Retail package testing is not conducive to checking very many lots of an individual product or a substantial amount of any single production lot. Thus, it is more difficult to detect generally good or bad packaging processes, and the impact of a single inspection on a packager and the packaging process is small. Therefore, at the very least, follow-up inspection of a particular brand or lot code number at a number of retail and wholesale outlets is extremely important in any retail checking scheme.

At the point of sale, a large number of processes impinge on the quality or quantity of the product. Hence, there may be many possible reasons for any inspection lot being out of compliance. A shortage in weight or measure may be the result of mistreatment of the product in the store, of a failure to rotate stock, of mishandling by a middle agent, or of failure of some part of the packaging process. Therefore, locating fault in order to correct defects will be more difficult when retail testing is employed.

Moisture Loss

Allowance for moisture loss during the course of good distribution practices must be made when Federal or State regulations provide for them. Allowances for moisture loss are not applied at point of pack testing, to hermetically sealed packages, or to pesticides.

1.3.2. What to Test

The products to be tested can be chosen in many ways. For a State or local government agency, the decision can be based on marketplace surveys (e.g., sales volume and sales value of various packaged goods) and audit testing (see Section 1.5.) to cover as large a product variety as possible at food stores, farm stores, drug, hardware, or specialty outlets, discount and department stores. Follow-up of possible problems detected in audit testing or in review of past performance will tend to concentrate inspection resources on particular commodity types, brand names, retail or wholesale locations, or even particular neighborhoods.

The expected benefits for the public must, of course, be balanced against the cost of testing. Expensive products should be tested because of their cost per unit; however, inexpensive items also should be tested because of their sales volume, the overall cost to individual purchasers becoming considerable over an extended period. Items on special sale and special products produced for local consumption should not be overlooked.

Some officials may have a roster of packaging plants (or an individual plant) to inspect for a broad range of items, one of which will include net quantity. In such cases, the official may be instructed as to what to test.

1.3.3. Special Precautions

In testing food, cosmetic, or drug products, the inspector must observe all health standards and regulations for handling the product. For the safety of the inspector and public, pesticides, herbicides, and other poisonous or hazardous materials should be handled (and, if necessary, disposed of) with extreme caution, observing all health standards and label warnings.

The procedures in this handbook are designed to be technically sound. The measurements and the recording of these measurements must be performed by the official carefully, so that they are also legally defensible. The forms and worksheets are designed to provide assurance that all the required data will be entered instead of leaving it to memory and judgment. For similar reasons, it is also important to maintain an unbroken "chain of custody" when taking sample packages back to a laboratory for further measurements.

1.4. INSPECTION BY SAMPLING

Weights and measures regulation, testing, and enforcement require a balance between the need to assure equity and the need to minimize the cost of testing to the taxpayer. Testing a "sample" of packages is one means of achieving this balance.

This handbook describes package compliance testing methods to be used in conjunction with sampling techniques.

The only alternative to sampling to determine compliance with package requirements is 100% testing. (See Section 1.6.)

The techniques of statistically sound sampling based on a sampling plan provide important benefits. First is conservation of the inspector's time needed to test a single lot, thus reducing the cost of such testing. Since testing entails some package destruction, package integrity can be preserved to a large extent by following a sampling plan.

A second benefit is the increased impact of an inspector on the package production, distribution, and marketing sectors. Sampling according to prescribed sampling plans is a most effective and efficient method of marketplace surveillance. Surveillance by sampling is an efficient means to protect package purchasers (who cannot check the quantity of contents themselves) and also to encourage good manufacturing and distribution processes among packagers and package sellers.

Compliance testing using a sampling plan utilizes a step-by-step method of obtaining evidence, comparing the evidence with package requirements, then making a decision about the compliance of the packages.

Sampling plans are discussed further in Sections 1.7. and 1.8. and in detail in Chapter 2. Inspection procedures using sampling plans consist of five steps:

- Define and count the number of packages comprising the "inspection lot", upon which action is taken. (The "inspection lot" is defined in Section 2.3., page 2-5.)
- Choose a random sample. (Instructions for taking a random sample are given in Appendix E.)
- Measure as appropriate each package in the sample (described in Chapters 3, 4, and 5).
- Perform calculations based on individual measurements (described in Sections 2.6. and 2.7. and as part of the package checking routine in Chapters 3, 4, and 5).
- Decide whether the "inspection lot" is in conformance with the requirements. This decision is based upon the criteria established in the sampling plan (described in Sections 2.6. and 2.7. and as part of the package checking routine in Chapters 3, 4, and 5).

1.5. AUDIT TESTING

In order to speed the process of detecting possible package net contents violations, officials often use audit testing procedures. These may entail, for example, very small sample sizes or predetermined and catalogued tare weights, or any other shortcut in testing.

Audit procedures are not definitive, but are fast and enable an inspector to cover more products at a single location than would otherwise be possible with the more rigorous techniques. An official who finds a possible violation should then use the more rigorous methods given in this handbook to confirm the condition of the lot, that is, to determine whether or not the packaged product complies with net contents labeling requirements. This handbook does not discuss audit testing at length, but does provide audit methods for packaged goods labeled by count (Section 5.1.2.) and for paint, varnish, or lacquers (Sections 4.9.2. and 4.9.3.).

Although mixed lot code testing is not intended just for audit testing, it can be a time saver for audit tests. When packages are checked at retail, inspection lots may be defined as identically labeled packages that are mixed with respect to lot code (helping to indicate a manufacturer's overall process quality). If testing reveals poor quality, segregation by lot code before further testing will simplify follow-up inspection.

1.6. 100% TESTING

Upon occasion, it may be necessary to check every package in a lot, shipment, or delivery.

State regulations and those of the Federal Trade Commission (see Appendix D) are specific in this instance:

- the average of a lot, shipment, or delivery must equal or exceed the labeled net contents;
- no "unreasonable" shortage in any package is permitted.

Other Federal requirements are not so explicit, but are compatible with the requirements noted above.

When every package in the lot is tested, no (zero) packages may fall below the limits set by the MAV, and, at the same time, the average quantity of contents of the lot, shipment, or delivery must equal or exceed the labeled quantity.[1]

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[1] See Section 5.7. for testing glassware, which is provided a tolerance.

If a packager uses checkweighers, not only should the average of the lot equal (or exceed) the label, but under no circumstances should the checkweigher accept packages that are short measure by more than the MAV.

1.7. SAMPLING PLANS FOR THE AVERAGE REQUIREMENT

Several categories of sampling plans are provided in this handbook. Two categories of sampling plans, Category A and Category B, are provided for testing packages subject to the average requirement.

The regulatory agency has the authority to specify the appropriate sampling plan categories according to the agency's operating procedures.

As mentioned in Section 1.2., packages must meet two requirements when they are subject to the average requirement. The first, which applies to the whole inspection lot, is that the average net contents must equal or exceed the labeled contents. The descriptions of the sampling plan categories have specific computations to provide evidence that this requirement has been met. The second requirement is that individual package variations may not be "unreasonable". The limits of reasonable individual package variations are called MAV's in this handbook. When using sampling techniques for compliance testing of packaged goods, a very few packages in any given sample may be allowed to exceed the limits defined by the MAV.

1.8. WHY THERE ARE TWO CATEGORIES OF SAMPLING PLANS

Judgments based on sampling (less than complete information) are by nature subject to uncertainty. There is an inherent risk of making wrong decisions. Lots that do not conform to the regulation may be mistakenly accepted and lots that do conform may be erreoneously rejected.

Many kinds of sampling plans can conceivably be devised, categorized according to their probability of accepting inspection lots whose average net contents at least equals the declared net contents. For the moment, we will set aside requirements on individual packages in our discussion of Category A and B plans.

Category B plans split the risks of making incorrect decisions between the packager and the consumer, giving acceptable inspection lots a 50% probability of acceptance. Category A sampling plans give acceptable inspection lots a "high" probability of acceptance.

Figure 1-1[1] illustrates some of the differences between Category A and Category B sampling plans.

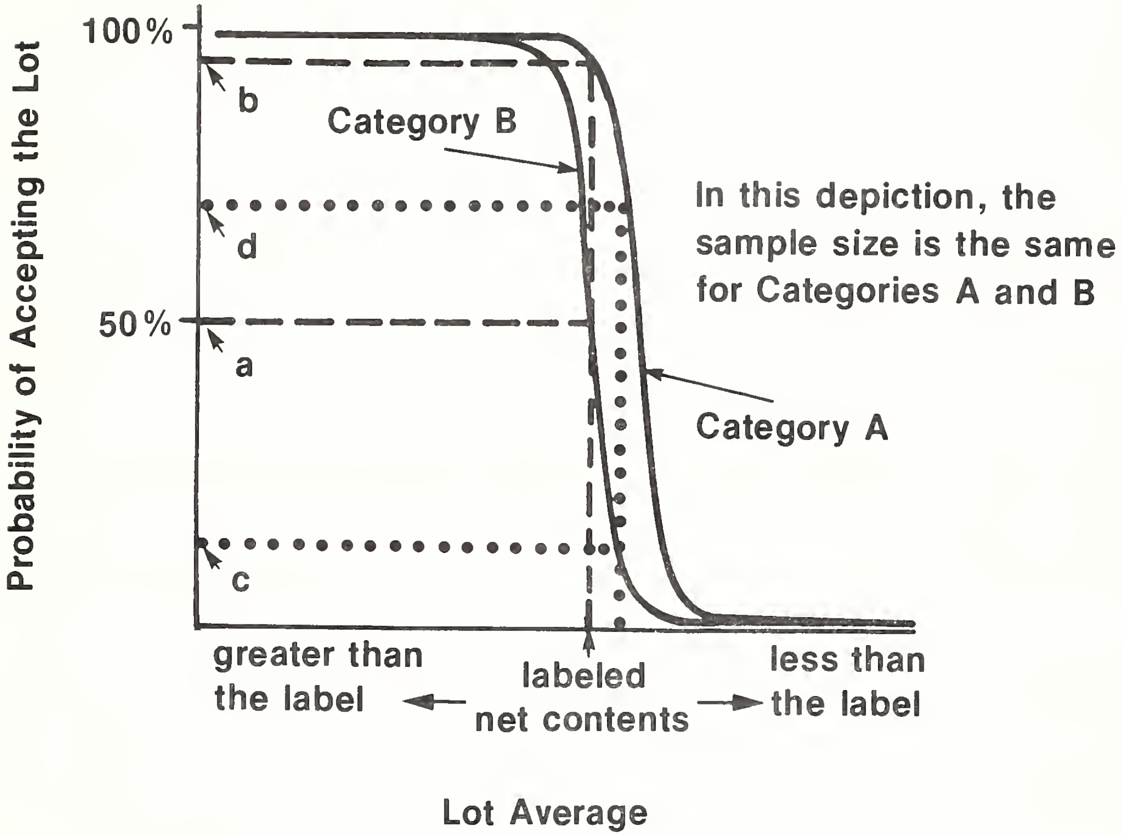

Figure 1-1. Differences between Category A and Category B.

Lots That Average at the Labeled Net Contents

For lots that average at the labeled net contents (see the dashed vertical line):

- o We expect Category B sampling plans to pass 50% of all such lots sampled (point "a").
- o We expect Category A sampling plans to accept a much larger percentage of all such lots sampled (point "b").

---

[1] This description has been greatly simplified by showing only lots that have a variability that fits well within the MAV limits. For further information, see G. N. Lauer, "Probabilities of Noncompliance for Sampling Plans in NBS Handbook 133", in the Journal of Quality Technology, Vol. 14, p. 162, July 1982.

Lots That Average Below the Labeled Net Contents

For lots that average less than the labeled net contents (see the dotted vertical line):

- The same relationship holds, that is, Category A plans pass a greater fraction of lots than do Category B plans (compare point d to point c) but,

- Both categories pass fewer below-average lots than lots that average at the labeled contents. (Compare point d to b and point c to a.)

Lots That Average Above the Labeled Net Contents

- The same relationship again holds, that is, Category A plans pass more lots than Category B plans, but

- The probability of such lots being passed by either Category increases, as one should expect.

It has been traditional in package testing in the U.S. for Federal, State, and local regulatory officials to use sampling plans similar to Category B. Frequently, many jurisdictions applied a variety of "allowances" to their measurement results before taking enforcement action. Category A sampling plans are provided in order to reduce the risk of failing a lot when it averages at the labeled weight. Category A plans provide a rational, uniform alternative to the variety of allowances or tolerances formerly in use.

In the foregoing discussion of differences between A and B, it was assumed that the sample sizes are the same for A and B. For any given sample size, however, Category A plans, while reducing the probability of rejecting "good" lots, increase the probability of accepting "bad" lots. The Category A plans have therefore been designed to reduce the risk of accepting too many "bad" lots while still providing reasonably high probability of accepting "good lots". As a result, the sample sizes (for any given lot size) for Category A are larger than those for Category B.

Because Category A plans require larger sample sizes and additional arithmetic computation, jurisdictions (in the interests of economy and practicality) may not find Category A suitable for routine testing purposes.

1.9. ALLOWANCES FOR VARIATIONS DUE TO MOISTURE LOSS OR GAIN

Some packaged products may lose or gain moisture (and, therefore, lose or gain weight) after packaging. Depending upon the nature of the product, its environmental history, and the packaging material and method, moisture loss may occur even when good distribution practices are followed. Whenever the Federal or State laws or regulations governing packaged products allow variations in individual packages for loss or gain of moisture[1], these allowances have to be applied to individual packages and, thus, to the average net contents before a decision as to lot conformance can be made.

On the basis of technical and regulatory information presently available, this handbook cannot provide definitive moisture allowances or procedures for determining compliance with those regulations that allow for quantity variations due to moisture loss or gain. (The agencies responsible for such regulations are listed in Table 1-1, page B-1.)

1.10. DECISIONS PRELIMINARY TO PACKAGE INSPECTION

Prior to any package inspections, the package testing official's supervisor or program administrator must, at the very least, give directions concerning:

- which sampling plan category is to be used under what circumstances in the jurisdiction, and
- what procedures are to be followed when inspecting packages susceptible to moisture loss.

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[1] Certain nonfood, packaged consumer items under the authority of regulations promulgated by the Federal Trade Commission are permitted variations "due to exposure". This may include solvent evaporation, not just loss of water.

CHAPTER 2. GENERAL CONSIDERATIONS

2.1. The package checking routine

2.2. The report forms and worksheets

2.3. Definition of the lot

2.4. Package errors

2.5. Selecting the sampling plan

2.6. Sampling plans in Category A

2.7. Sampling plans in Category B

2.8. Individual packages

2.9. Recording package errors

2.10. The criteria for weighing packages not labeled by weight

2.11. Tare

2.12. MAV's

2.13. Exceptions to the MAV's

2.14. Moisture allowance

CHAPTER 2. GENERAL CONSIDERATIONS

This chapter introduces several subjects that require special study by the inspector prior to actual package testing. Chapter 2 provides explanations on how to define the group of packages upon which action will be taken, how to fill out a report form, how to read the tables in Appendix B, and how to perform the arithmetic required in the procedures in chapters 3, 4, and 5. This chapter also describes general principles that will be followed throughout the handbook concerning measurement accuracy (the MAV/6 principle), recording package errors (using dimensionless units), the criteria for weighing packages not labeled by weight, and information on tare. A thorough study of Appendix E is also recommended before using the methods detailed in Chapters 3, 4, and 5.

2.1. THE PACKAGE CHECKING ROUTINE

The following topics in capital letters are explained in this chapter and in Appendix E, but not necessarily in the order in which the official will handle them during field testing. Step-by-step instructions for field testing are given in Chapters 3, 4, and 5.

In package testing, after determining the location of test and packaged product to be tested, the official will be expected to:

- identify the INSPECTION LOT to be tested,
- fill out a REPORT FORM, including information from the product label and the MAV (selected according to the labeled net contents),
- count the number of packages in the lot and record the LOT SIZE,
- refer to the designated SAMPLING PLAN and record SAMPLE SIZE, TARE SAMPLE SIZE, and ALLOWED NUMBER OF UNREASONABLE ERRORS,
- select a RANDOM SAMPLE and the RANDOM TARE SAMPLE,
- if label is not in terms of net weight, determine if WEIGHING METHOD may be employed (using one of the WORKSHEETS),
- determine UNIT OF MEASURE and the MAV in DIMENSIONLESS UNITS (the use of dimensionless units is optional),

- determine AVERAGE TARE (and CORRECTED TARE in some instances), and record on WORKSHEETS and REPORT FORM,

- determine PACKAGE ERRORS (using a NOMINAL GROSS WEIGHT where possible), and record values on REPORT FORM, and

- apply DECISION CRITERIA to determine whether the lot does or does not conform to net quantity requirements.

Tables and other material introduced in this chapter are referenced in Chapters 3, 4, and 5 when circumstances require their use. All report forms and worksheets appear in Appendix A and all tables are in Appendix B.

2.2. THE REPORT FORMS AND WORKSHEETS

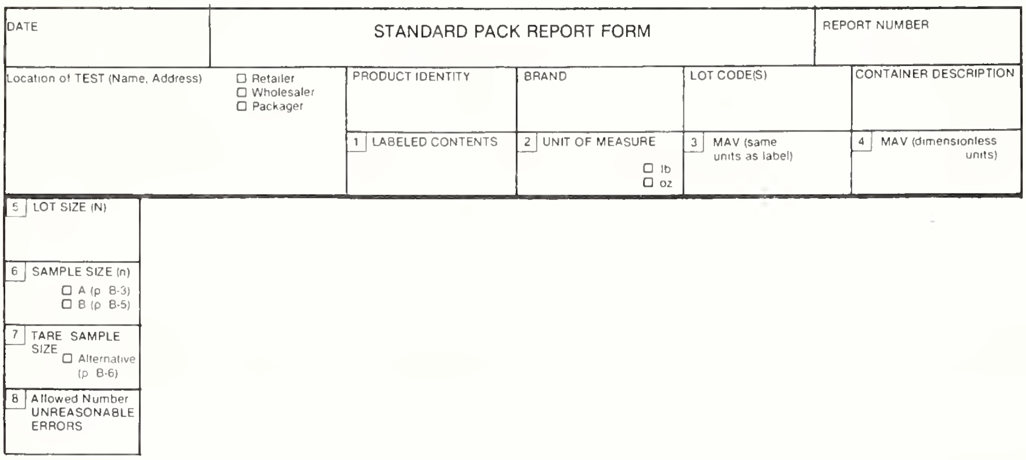
It is necessary to document the results of package testing on a report form. An example of a form for standard pack packages is shown on page A-1. In the following sections and in subsequent chapters, the official will be referred to locations indicated by box numbers on this report form. Chapters 3 and 4 introduce other report forms, derived from this example.

Several worksheets are also introduced in Chapters 3, 4, and 5 and Appendix E.

For those reading the handbook for the first time, we suggest that the reader keep handy a copy of the report form on page A-1 and refer to it while reading the text. The numbered boxes are listed in Table 2-1 (on page B-2), together with the sections of the text in which they are explained. In addition, the page numbers of the look-up tables in the handbook are printed in the report form boxes.

2.2.1. Filling Out the Report Form Heading

The report form on page A-1 provides boxes for recording all the pertinent information for the simplest type of package — the "standard pack" package. (See Section 2.3.1. for a definition of "standard pack".) Figure 2-1 shows the report form heading. Lot code information will help in follow-up testing. The labeled net contents is recorded in box 1. It is used to look up the "MAV", which is to be entered in box 3 (see Section 2.12.). The selection of a "unit of measure" (box 2) is also guided by the labeled net contents. (See Sections 2.9.1. for general information about the "unit of measure", 3.3. for packages labeled by weight, and 4.4. for packages labeled by volume.) ("Dimensionless units" (box 4) will also be explained in Section 2.9.1.) The official must first designate the "inspection lot" before determining the size of the lot to be tested (box 5). This is described in Section 2.3. Once the size of the lot is known, the official can look up the appropriate sample size (box 6), tare sample size (box 7), and the number of package errors allowed to exceed the MAV (box 8) in Table 2-2 (Category A) or Table 2-5 (for Category B plans).



DATE	STANDARD PACK REPORT FORM				REPORT NUMBER
Location of TEST (Name, Address)	☐ Retailer ☐ Wholesaler ☐ Packager	PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION
		1 LABELED CONTENTS	2 UNIT OF MEASURE ☐ lb ☐ oz	3 MAV (same units as label)	4 MAV (dimensionless units)

5 LOT SIZE (N)

6 SAMPLE SIZE (n)
☐ A (p B-3)
☐ B (p B-5)

7 TARE SAMPLE SIZE
☐ Alternative (p B-6)

8 Allowed Number UNREASONABLE ERRORS

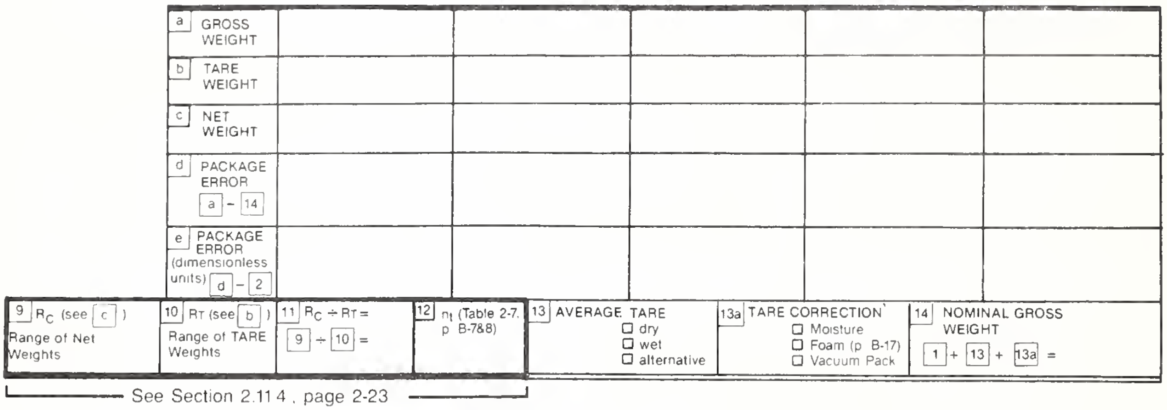
Figure 2-1. The standard pack report form heading.

2.2.2. Filling Out the Tare Information on the Report Form

The determination of tare is covered generally in Section 2.11. The next section of the report form (see Figure 2-2) provides space to record the "gross weight" (unopened total package weight) in boxes labeled "a" and the "tare weight" in boxes labeled "b" for up to five packages. An additional worksheet may be appended if more than five packages are opened to determine tare. This section of the report form is used when the packages are labeled by weight. Special worksheets are provided to record this information for packages labeled in other units (volume, count, etc.).

Section 2.11.4. describes a special method to be used when tare variability is appreciable with respect to the variability of the net weight (boxes 9 through 12).

The average tare weight is recorded in box 13 and any corrections to the tare are entered in box 13a. Box 14 is used to record the "nominal gross weight", the weight against which all package gross weights will be compared to determine the package errors.



a GROSS WEIGHT					
b TARE WEIGHT					
c NET WEIGHT					
d PACKAGE ERROR a - 14					
e PACKAGE ERROR (dimensionless units) d - 2					

9 R_C (see c) Range of Net Weights	10 R_T (see b) Range of TARE Weights	11 $R_C \div R_T =$ 9 ÷ 10 =	12 n_t (Table 2-7, p B-7&8)	13 AVERAGE TARE ☐ dry ☐ wet ☐ alternative	13a TARE CORRECTION ☐ Moisture ☐ Foam (p B-17) ☐ Vacuum Pack	14 NOMINAL GROSS WEIGHT 1 + 13 + 13a =

See Section 2.11.4, page 2-23

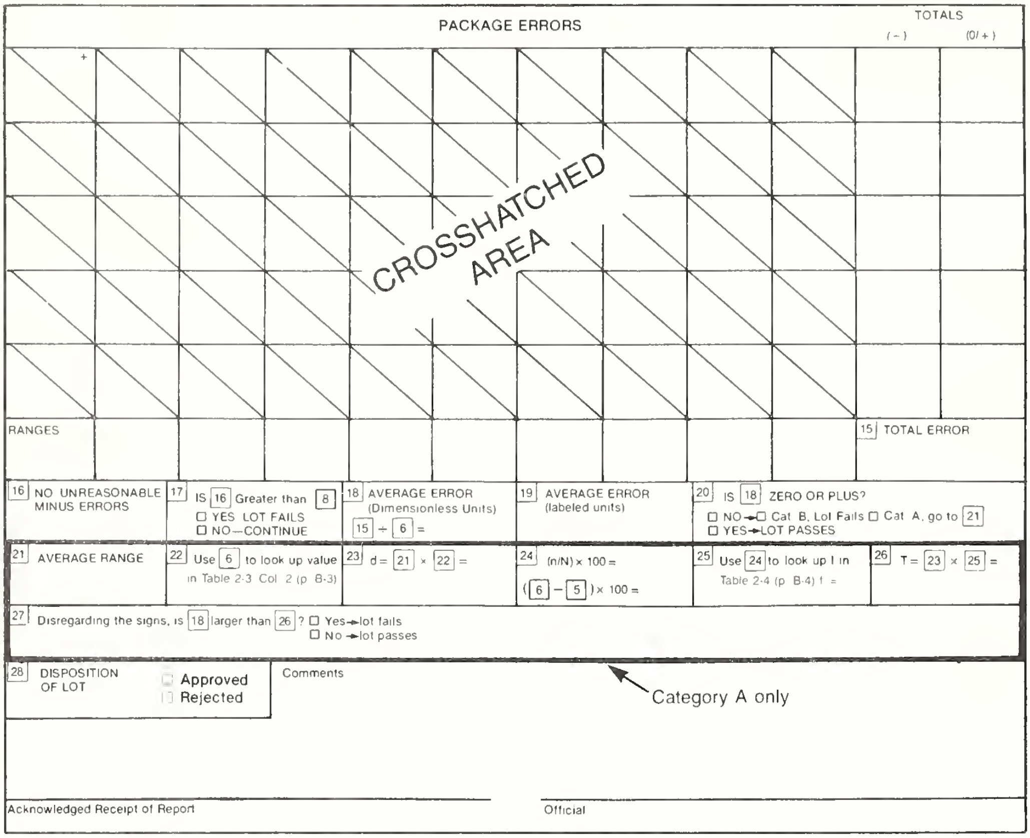
Figure 2-2. Places to record tare sample information and the nominal gross weight on the standard pack report form.

2.2.3. Recording Package Errors and Determining Whether the Lot Conforms to the Requirements.

Section 2.9.3. describes how to record package errors in the crosshatched area of the report form. See Figure 2-3.

Appendix H explains how to calculate a "range" (R). The actual number of "unreasonable errors" (box 16) and the criterion for individual package errors (box 17) are explained in Sections 2.6.1. (for Category A plans) and 2.7.1. (for Category B). The "average error" (boxes 18 and 19) is explained in Sections 2.6.2. (Category A) and 2.7.2. (for Category B). The special additional steps (boxes 21 through 27) to determine lot conformance when following a Category A sampling plan (when the average error is a minus value) are described in Section 2.6.2.

The final disposition of the lot is recorded in box 28 and is a composite of the information recorded in boxes 17, 20, and 27.



PACKAGE ERRORS

TOTALS (−) (0/+)

CROSSHATCHED AREA

RANGES

15 TOTAL ERROR

16 NO UNREASONABLE MINUS ERRORS

17 IS 16 Greater than 8 ☐ YES LOT FAILS ☐ NO—CONTINUE

18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 =

19 AVERAGE ERROR (labeled units)

20 IS 18 ZERO OR PLUS? ☐ NO→☐ Cat B, Lot Fails ☐ Cat A, go to 21 ☐ YES→LOT PASSES

21 AVERAGE RANGE

22 Use 6 to look up value in Table 2-3 Col 2 (p B-3)

23 d = 21 × 22 =

24 (n/N) × 100 = (6 − 5) × 100 =

25 Use 24 to look up t in Table 2-4 (p B-4) t =

26 T = 23 × 25 =

27 Disregarding the signs, is 18 larger than 26? ☐ Yes→lot fails ☐ No→lot passes

28 DISPOSITION OF LOT ☐ Approved ☐ Rejected

Comments

Category A only

Acknowledged Receipt of Report

Official

Figure 2-3. The crosshatched area of the report form and place to record lot disposition.

2.3. DEFINITION OF THE LOT

As a first step in package testing, the official designates the collection of packages upon which action will be taken as a result of the official's tests. This is the "INSPECTION LOT". Based on the factors likely to cause variations in quantity, the official should designate as the inspection lot the largest possible group of packages, in accordance with the following guidelines:

(i) The inspection lot must consist only of packages of the same product, with the same label (except for the lot code), from the same packer.

For example, a lot shall consist of cans of peach halves, syrup added, 500 grams net weight, Brand X.

This rule should never be violated.

(ii) To the greatest extent possible, the inspection lot should consist only of packages packed at the same place, at the same time, under the same conditions. This guideline is in addition to the provisions of guideline (i). Therefore, a lot should consist of packages of the same product and the same label. They should also have the same lot code number if inspection is done at the warehouse, or be packages from the same filling line, packed during the same period, if inspection is done on-line at the packing plant.

It is not always possible to take the second guideline into account in designating lots. In fact, taking both guidelines into account may lead to a very small inspection lot, a result which is undesirable. The inspection lot should be as large as possible without violating guideline (i), yet taking into account the factors mentioned in guideline (ii).

If the official cannot reach some packages because of physical or other constraints, those packages are not part of the inspection lot to be acted upon. In general, such restrictions on sampling should be avoided whenever possible.

State and local regulations apply to "lots", "shipments", or "deliveries". A shipment or delivery will rarely be comprised of only one or two packages. If only one or two packages are found on retail shelves, more packages should be sought in storerooms or cases. When only one or two packages are available for test in a single location and it is evident that the shipment or delivery was larger, the average net contents of the shipment or delivery cannot be determined. Only individual package errors can be ascertained and compared with the limits of reasonable variation (called "MAV's"). If shortages are found for one or two packages, records should be kept and follow-up inspections conducted on larger lots or in other locations.

2.3.1. The Inspection Lot of Standard Pack Packages

"Standard pack" packages are defined as those packaged with identical labels in a few selected quantity sizes. For example, canned ham labeled "5 pounds" is a standard pack meat item.

The inspection lot must always consist of packages with identical labels (except for the lot code).

- When the location of test is a retail store: Because state and local regulations apply to "lots, shipments, or deliveries", a shipment or delivery comprised of packages with different lot codes may be acted upon as a single inspection lot. Follow-up inspection will require segregation of lots by lot code.

- When the location of test is a warehouse: The inspection lot must consist of packages with the same manufacturer's lot code.

- When the location of test is on-line at a packing plant: The inspection lot must consist of packages with the same manufacturer's lot code and should not exceed one uninterrupted production run. As small as one hour's production may be convenient for sampling purposes.

Note that the inspection lot is not, in general, the same as the "production lot".

2.3.2. The Inspection Lot of Random Pack Packages

"Random pack" packages are defined as those packaged with identical labels except for the labeled quantity.[1] These packages are usually individually weighed and subsequently marked.

An example of a random pack meat item is whole chicken labeled by weight.

- When the location of inspection is a retail store: An inspection lot may consist of all the packages packaged at that location and available for inspection at one time. Since the same production factors apply to all such packages, the entire meat counter, for example, may be considered the lot, except for those packages on the counter put up elsewhere than at the store. (See Appendix E for more discussion on selecting the sample from this kind of lot.)

  State and local regulations apply to "lots, shipments, or deliveries". A shipment or delivery comprised of packages with different codes may be acted upon as a single inspection lot. Follow-up inspection will require segregation of lots by lot code.

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[1] The National Conference on Weights and Measures Uniform Packaging and Labeling Regulation (NBS Handbook 130) defines a "random pack package" as a "package that is one of a lot, shipment, or delivery of packages of the same consumer commodity with varying weights; that is, packages of the same consumer commodity with no fixed pattern of weight." The procedures in this handbook for random pack packages apply to consumer and non-consumer packages with quantity declarations of weight or of other measures.

- Upon occasion, the official may wish to define a lot of only one kind of packaged goods (e.g., ground beef) for special reasons, such as the large number of packages of one kind of goods, prior history of product or store, the unit price of the product, or because the results of audit testing indicate the possibility of shortage in a particular item.

- When location of inspection is either a warehouse or on-line at the packaging plant, the definition of the inspection lot is the same as that for standard pack packages except that "identical labels" is construed to mean identical except for the numerical quantity of contents.

2.3.3. Size of the Inspection Lot

Refer to discussion on the definition of lot (Section 2.3.) for further information on forming the inspection lot from which a sample will be drawn. Count the number of packages in the inspection lot. This is the size of the inspection lot, (N), to be entered on the report form (page A-1) in box 5.

2.4. PACKAGE ERRORS

In general, the actual package quantities that the official measures will not be the same as the labeled quantity. The deviation from the labeled quantity, rather than the actual package quantity, is the matter of interest to the official. Hence, positive or negative deviations from the label (called plus or minus errors or, in general, "package errors") will be the focus of the procedures in this handbook.

Package Error = (Measured Net Contents) - (Labeled Net Contents)

The official will record the individual package errors on the report form and then determine lot conformance based on these package errors.

2.5. SELECTING THE SAMPLING PLAN

The average requirement applies to the vast majority of packages to be tested, and Category A or B plans (described below) should be used in these instances. Special sampling plans for pressed and blown glass tumblers and stemware are presented in Section 5.7. (pages 5-20 and B-23). Special sampling plans must be used for packages labeled by count and containing less than 51 units per package. These plans are introduced in Section 5.2. (pages 5-5 and B-22).

All the sampling plan tables (Table 2-2, 2-5, 5-1, or 5-2) are tabulated according to lot size. The official may use a larger sample size (a line further down the table) but must follow the entire sampling plan (all of the corresponding horizontal line).

The official enters the tables by finding the horizontal line that corresponds to the size of the inspection lot (first column). The other columns detail the size of the sample (second column), the number of packages to be selected for tare determination (third column) and the number of individual packages permitted to exceed a "reasonable" value (last column).

2.6. SAMPLING PLANS IN CATEGORY A

Table 2-2 on page B-3 lists six sampling plans according to the inspection lot size, N, indicated in column 1. For each plan,[1] column 2 indicates the number of packages to be chosen at random from the lot; this is the "sample size", n. Appendix E describes several methods for obtaining a random sample. (Note the special precautions for sample selection on page E-10.) Column 3 of Table 2-2 indicates the number of packages to be chosen randomly from the sample or from the stock of unused tare materials for determination of tare; this is the "tare sample size". Appendix E also describes methods for tare sample selection. Column 4 indicates the number of minus package errors that are allowed to exceed the MAV. (This is the allowed number of unreasonable errors.)

After recording the lot size in box 5 on the report form (page A-1), the official selects a sampling plan according to the lot size and records the corresponding sample size in box 6 (checking that a Category A plan is being followed). The corresponding tare sample size is recorded in box 7 and the allowed number of unreasonable errors is recorded in box 8 on the report form.

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[1] Sample sizes of 50 and over are the same as those in Military Standard 105-D, but the sampling plans are not the same as Military Standard 105-D because the decision criteria are different. In addition to the decision criterion for individual packages (Section 2.6.1), the lot must also pass the decision criterion for the average (Section 2.6.2).

As mentioned in Section 2.5., Table 2-2 lists the minimum sample size to be used for any given lot size. A larger sample size may be chosen at any time as long as the official follows the entire sampling plan (all of any given horizontal line, including the decision criteria corresponding to that sampling plan and that line). For example, the official may choose to take a sample size of 50 for a lot of 750 packages, rather than a sample of 30. However, the official must also take 5 packages to determine the tare and the lot can be considered out of conformance only if 3 or more packages in the sample of 50 are short measure by more than the MAV from the labeled quantity (or if the sample fails the average error requirement).

Obviously defective individual packages are not to be selected from the inspection lot to become part of the sample. (See Appendix E for guidance in this situation.) However, obviously defective packages should not be reintroduced into commerce.

After the quantity of contents in each sample package is measured and recorded, the decision criteria of the plan are applied. The decision criteria indicate the conformance or nonconformance of the lot with the package requirements.

2.6.1. Decision Criterion: Individual Packages

First, conformance is checked with the package requirement that permits individual packages to differ from the labeled quantity by a "reasonable" amount. The package error (see Section 2.4.) for each package in the sample is compared to the MAV for that package type and size. (See Section 2.12. for more information about MAV's.) The minus errors that exceed the MAV are called "UNREASONABLE ERRORS". If the number of unreasonable errors exceeds the limit indicated in column 4 of Table 2-2 (page B-3) (corresponding to the sample size), the lot fails to conform with the package requirements. No further testing of the lot is necessary. On the report form on page A-1, the allowed number of unreasonable errors from column 4 of Table 2-2 is recorded in box 8 and the individual package errors in the crosshatched area of the report form. (See Section 2.9. for more information about recording package errors.) Each minus package error that exceeds the MAV should be circled on the report form and the number of circled package errors (the number of unreasonable errors) should be recorded in box 16 on the report form.

For example, the MAV for a 12 oz package is 0.036 lb (found by looking up the MAV in Table 2-8). Suppose the lot size is 500 packages. Table 2-2 indicates that a sample size of 30 and tare sample of 2 is to be selected. Column 4 of Table 2-2 indicates that only one package may exceed the MAV. A "1" is therefore entered in box 8 on the report form. Suppose that three packages in the sample of 30 are short weight by more than 0.036 lb. They are circled and a "3" is entered in box 16. Since this value is greater than the value in box 8, the "yes" box is checked in box 17. The lot, in this example, fails to conform to the net contents requirements.

If the number of unreasonable errors in the sample (recorded in box 16) is less than or equal to the number recorded in box 8, the lot complies with this first requirement. The average error must then be computed according to Section 2.6.2. before a final decision can be made as to the compliance of the lot with net quantity regulations.

When the lot size is 30 or less, all packages are tested. The lot is nonconforming if any minus package errors exceed the MAV. (This corresponds to 100% testing.)

2.6.2. Decision Criterion: The Average Error

The "average error" for the sample is computed by dividing the sum of the individual package errors (called the "total error" and recorded in box 15 on the report form on page A-1) by the number of packages in the sample (box 6). (The use of the crosshatched area of the report form to compute the average error is described in Section 2.9.3.) The average error is recorded in boxes 18 and 19 on the report form. "Dimensionless units" are explained in Section 2.9.1. If the total error (and, consequently, the average error) is zero or a positive number, a final decision on the lot can be made at this point; that is, the lot conforms with the package net quantity requirements.

When the lot size is 30 or less, all packages are tested; the lot is nonconforming if the total error has a minus value. (This corresponds to 100% testing.)

When the sample average is minus, the statistical terms "d", "f", and "T" are computed (as described below) and used to determine whether the lot conforms.

(i) First compute "d".

$d = \bar{R} \times (0.8598/\sqrt{n})$

where

$\bar{R}$ is the average range of package errors for groups of 5 packages taken in the order of weighing and n is the number of packages comprising the sample. (Appendix H contains a detailed example of how to calculate $\bar{R}$.)

For the convenience of the official, Table 2-3 in column 2 (page B-3), gives values of $0.8598/\sqrt{n}$ for each sample size to use in the calculation of d.[1]

$\bar{R}$ is recorded in box 21 and the value from column 2 of Table 2-3 is recorded in box 22 on the report form.

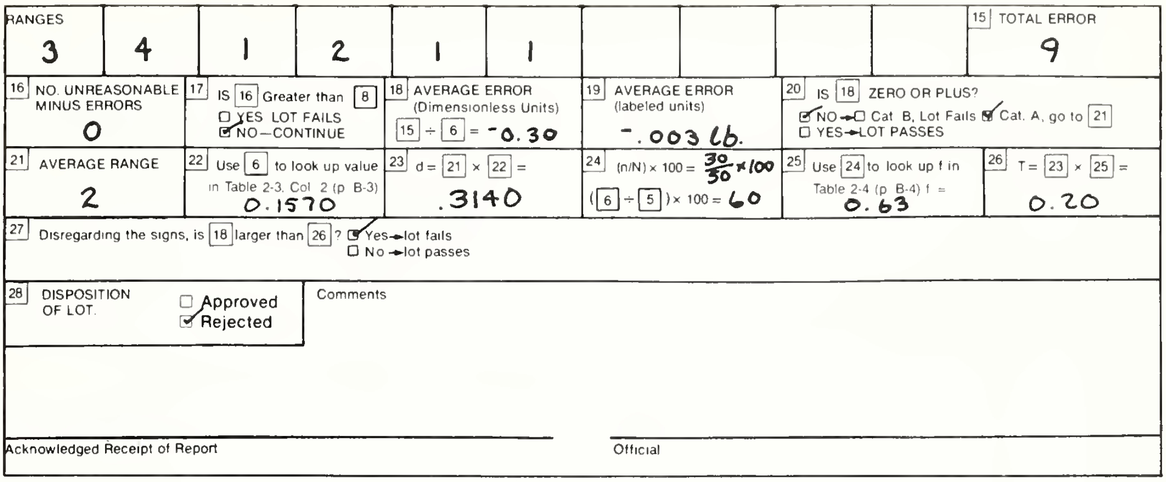
For example, if the sample size is 30, and $\bar{R} = 2$,

d (= Table 2-3, column 2 value x $\bar{R}$) = (0.1570) x (2) = 0.3140. See Figure 2-4 for example.

d is recorded in box 23 and, as indicated on the form, is the value recorded in box 21 multiplied by the value in box 22.

---

[1] Alternatively, a calculator which gives "standard deviation" directly may be used to determine d. Since commonly available hand calculators may not have enough storage capacity to calculate the standard deviation for large sample sizes, the average range method, described above, is acceptable. If a calculator that gives the standard deviation is being used, $d = 2s/\sqrt{n}$, where s is the standard deviation and n is the number of packages comprising the sample. For convenience, Table 2-3, column 3 gives values of $2/\sqrt{n}$ to use in this calculation. Slightly different values for d will be obtained using the standard deviation rather than the average range. If the standard deviation is used in the calculation, the report form must be modified to indicate the Table 2-3, column 3, value in box 22.



RANGES 3	4	1	2	1	1					15 TOTAL ERROR 9

16 NO. UNREASONABLE MINUS ERRORS: 0

17 IS 16 Greater than 8 ☐ YES LOT FAILS ☑ NO—CONTINUE

18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 = -0.30

19 AVERAGE ERROR (labeled units) -.003 lb.

20 IS 18 ZERO OR PLUS? ☑ NO → ☐ Cat B, Lot Fails ☑ Cat. A, go to 21 ☐ YES → LOT PASSES

21 AVERAGE RANGE: 2

22 Use 6 to look up value in Table 2-3, Col 2 (p B-3) 0.1570

23 d = 21 × 22 = .3140

24 (n/N) × 100 = $\frac{30}{50} \times 100$ (6 ÷ 5) × 100 = 60

25 Use 24 to look up f in Table 2-4 (p B-4) f = 0.63

26 T = 23 × 25 = 0.20

27 Disregarding the signs, is 18 larger than 26 ? ☑ Yes → lot fails ☐ No → lot passes

28 DISPOSITION OF LOT. ☐ Approved ☑ Rejected

Comments

Acknowledged Receipt of Report

Official

Figure 2-4. Example of calculation of T.

(ii) Calculate the percentage of the lot that the sample represents.

For example, if the lot consists of 50 packages (N) and a sample of 30 packages (n) is to be selected from the lot, the sample represents 30/50 x 100 = 60% of the lot. This value is recorded in box 24 on the report form. See Figure 2-4.

(iii) Look up "f", listed in Table 2-4 on page B-4, based on the percentage of the lot that the sample represents (as recorded in box 24). The value of f from Table 2-4 is recorded in box 25 on the report form.

For the above example, the f value is 0.63. See Figure 2-4.

(iv) Calculate "T",

T = d x f

Record T in box 26 on the report form (where it is indicated that T is the value in box 23 times the value in box 25).

Following the above example, with d = 0.3140 and f = 0.63, T = d x f = 0.20. See Figure 2-4.

]

(v) Compare the observed average error with T to determine lot conformance. If the average error recorded in box 18 (disregarding its minus sign) is larger than T, the lot does not conform with the package requirements. Record results in box 27.

In the above example, the average error is -0.30, hence the lot fails to comply with the package requirements since the value in box 18 (-0.30) disregarding its sign is larger than the value in box 26 (0.20). See Figure 2-4.

It should be remembered that the calculations in steps (i) through (v) above have to be made only when the average error is minus.

2.7. SAMPLING PLANS IN CATEGORY B

Table 2-5 on page B-5 provides the two Category B sampling plans. Depending on the size of the lot,(N), shown in column 1, column 2 indicates the number of packages to be chosen at random from the lot (the "sample size", n) and column 3 shows the number of packages that must be opened to determine the average tare ("tare sample size"). Column 4 shows that **no (zero)** packages are permitted to exceed the MAV. On the report form on page A-1, the lot size is recorded in box 5, the sample size in box 6 (check the box indicating that a Category B plan is being followed), and the tare sample size in box 7. A zero is recorded in box 8.

Obviously defective individual packages are not to be selected from the inspection lot to become part of the sample. (See Appendix E for guidance in this situation.) However, obviously defective packages should not be reintroduced into commerce.

After the quantity of contents in the sample packages is measured and recorded, it is then necessary to compare these measurements with the package requirements.

2.7.1. Decision Criterion: Individual Packages

Minus package errors that exceed the magnitude of the MAV (Section 2.12.) are called "UNREASONABLE ERRORS". Category B permit no unreasonable errors in the sample. (See Column 4 of Table 2-5.)

On the report form on page A-1, the number of unreasonable errors found in the sample is recorded in box 16.

If there are any unreasonable errors in the sample, the lot fails to conform with the individual package requirement (see box 17 on the report form). No further testing is necessary to determine lot conformance.

If there are no unreasonable errors in the sample, the total error and the average error must be calculated before making a final decision on the conformance of the lot.

2.7.2. Decision Criterion: The Average Error

The "average error" of the sample is calculated from the values obtained from individual package measurements. The average error is obtained by dividing the sum of the individual package errors in the sample (called the "total error" and recorded in box 15 on the report form) by the number of packages in the sample (box 6).

If the total error (and consequently the average error) is zero or a positive number, the lot conforms with the package requirements. If the total error (and consequently the average error) is minus, the lot fails to conform with the package requirements.

The average error is recorded in boxes 18 and 19 on the report form. (Dimensionless units are explained in Section 2.9.1.) Whether the average error is a zero, plus, or minus value is recorded in box 20.

2.8. INDIVIDUAL PACKAGES

Even when a lot complies with the package requirements as determined by either a Category A or B sampling plan, individual packages in the sample may be short weight or measure by more than the MAV from the labeled quantity. However, any individual package that is short by more than the MAV from the labeled quantity is considered defective. Defective packages should not be reintroduced into commerce.

Disposition of such packages may be recorded on the report form on page A-1, for example, under "Comments".

2.9. RECORDING PACKAGE ERRORS

Measurement details are described in Chapters 3, 4, and 5. This section describes the method for recording measurement results on the report form.

2.9.1. The Unit of Measure and Dimensionless Units

It is convenient to record package errors in terms of "dimensionless integers" or "dimensionless units". Mechanical package testing scales are traditionally designed to be read either in terms of units of weight or in terms of the number of scale graduations (see Figure 3-2, page 3-2). When recording scale readings in terms of the number of scale graduations without regard to their weight value, the inspector is using "dimensionless units". Package errors must be multiplied by the value of the scale graduation (called the "unit of measure") in order to arrive at the actual package error in weight units. For example, assume that an official measures package errors to the nearest 0.002 lb. The scale used to weigh the packages has 0.002-lb divisions on its face. If an individual package error is "-0.022 lb", the official may record the unit of measure as 0.002 lb, count the number of divisions on the scale face, then record this number as the individual package error, here "-11".

It is possible to use this type of notation with electronic digital scales as well. If an electronic device reads out to 0.001 lb, the inspector may record the unit of measure as 0.001 lb and then record package errors without regard to the decimal place.

The report forms on pages A-1 and A-3 are designed on the assumption that dimensionless units will be used. Other forms may be designed to provide more room for recording individual package errors with the units of weight (or other measure) for each package.

It is essential that all comparative values be converted to dimensionless units as well, or else the package measurements must be converted back to the units of measure.

Following the earlier example, suppose the MAV for these packages is 0.020 lb. The official converts the MAV to a dimensionless unit by dividing by the unit of measure used to record the package errors. With a unit of measure of 0.002 lb, the MAV in dimensionless units =

$$\frac{0.020 \text{ lb}}{0.002 \text{ lb}} = 10.$$

On the report form on page A-1 the unit of measure is recorded in box 2 (i.e., 0.002 lb). The MAV in dimensionless units is recorded in box 4 (i.e., 10).

2.9.2. Choosing the Unit of Measure

As a general rule, the official should record package measurements in a unit of measure less than or equal to the MAV/6. This is consistent with the principle expressed in NBS Handbook 44[1] that the error of standards used without correction "should be not greater than 25 percent of the smallest tolerance to be applied when the standard is used." Since packages must meet both the individual package requirement and the average requirement, errors made in individual package measurements are additive (and do not cancel one another). Therefore the 1:4 principle is tightened to 1:6, a ratio well suited to readily available testing equipment. For example, the MAV for packages labeled 2.50 lb is 1 3/8 oz (see Table 2-8 page B-10.) MAV/6 is 0.229 oz. Since a 1/4 oz unit is larger than 0.229 oz, a 1/8 oz unit of measure would be the largest appropriate for recording measurements on these packages.

In Chapter 3, Table 3-1 presents recommended maximum units of measure to be used in recording package weights when the packages are labeled by weight and in Chapter 4, Table 4-2 presents maximum units of measure for common consumer products labeled by liquid volume.

It should be kept in mind that the MAV's for packages labeled in units other than weight (Tables 2-9, 2-10, or 2-11) apply to such packages, even though weighing may be the means of package contents measurement. For example, packages labeled "48 fl oz" have an MAV of 1.25 fl oz. Assume that an inspector finds that 32.00 fl oz of the product under test weighs 2.000 lb. Then, the MAV of 1.25 fl oz is equivalent to:

$$\frac{(1.25 \text{ fl oz})\ (2.000 \text{ lb})}{(32.00 \text{ fl oz})} = 0.0781 \text{ lb}$$

The MAV/6 value is 0.013 lb or about 3/16 oz. In this instance, therefore, 1/8-oz units (or 0.008-lb units) are appropriate for testing the packages. If these same 48-fl oz packages had a weight of 1.000 lb for each 32 fl oz, the MAV of 1.25 fl oz would be equivalent to only 0.0391 lb and MAV/6 = 0.007 lb. Thus, units of 1/16 oz (or 0.004 lb) would be a better choice for measuring these packages.

Equipment used to measure package quantities should be capable of discriminating measurements to 1/6 of the MAV for an individual package. This handbook suggests equipment that meets this criterion.

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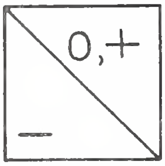
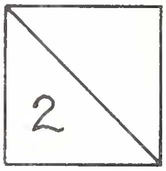
[1] Section 1.11. Fundamental Considerations, Subsection 3.2, NBS Handbook 44,"Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Equipment", revised and printed each year by the U.S. Government Printing Office.

2.9.3. How to Use the Crosshatched Area of the Report Form

On the standard pack report form on page A-1, package errors are entered in the "crosshatched" area[1]. Five values are entered down the first column, then the next five in the second column, and so on. This area of the form is designed to aid the official in summing the individual package errors and determining the range of package errors (Computations are explained in Section 2.6. and Appendix H.) Each package error is entered in a two-triangle block according to the following scheme:

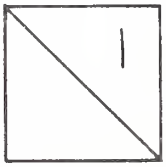


If the package error is minus, it is entered in the lower left triangle of the block:



This example indicates a package error of -2.

If the error is plus, it is entered in the upper right triangle of the block:



This example indicates a package error of +1.

Zero errors are also recorded in the upper right triangle of the block.

When checking sample sizes greater than 50, additional report forms must be used to record the package errors.

To obtain the sum of package errors, add the individual package errors horizontally across the rows in the crosshatched area, separately adding lower left and upper right triangles. Record the sum of each horizontal row in the "totals" column on the extreme right, then add up the rightmost column, taking care to observe the plus and minus values. (See Figure 2-5 for an example.) Record the total error in box 15. The average error of the sample is obtained by dividing the total error by the number of packages in the sample. The average error is recorded in box 18.

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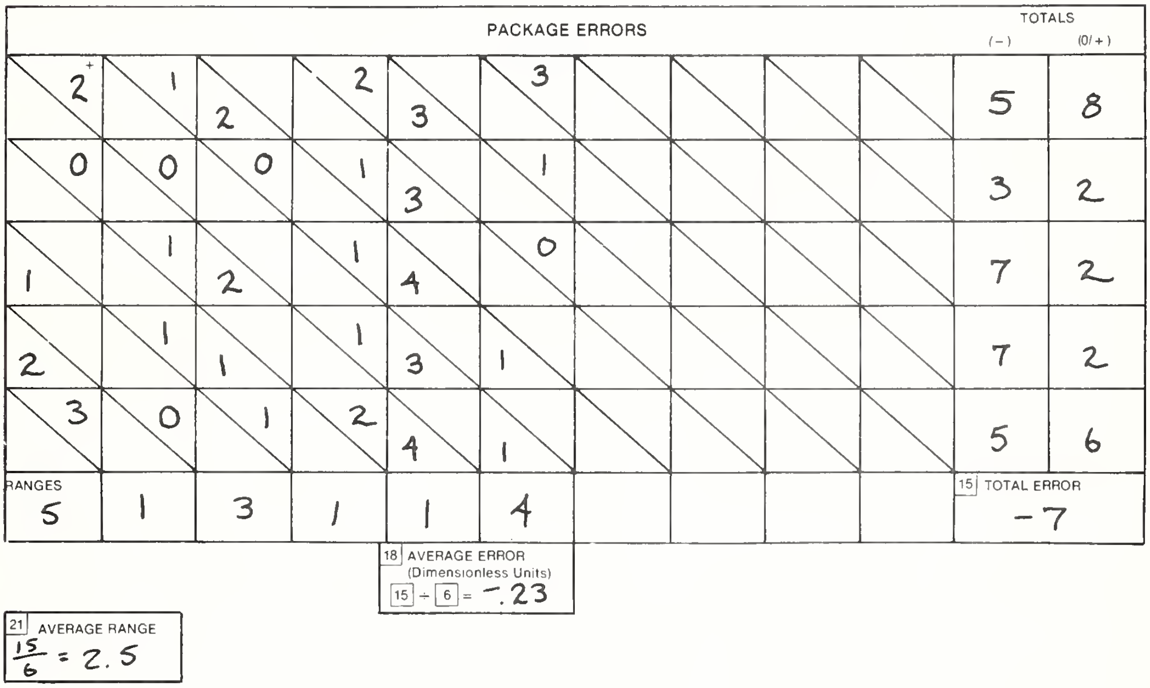
[1] This portion of the report form is based on that of the Division of Measurement Standards, Department of Food and Agriculture, State of California (Report Form 524-003).

In order to obtain the average range needed for Category A, the range for each set of five package errors (each column of package errors) can be recorded at the bottom of the crosshatched area in the spaces marked "Ranges".

Follow Appendix H for determining the range for each group of five packages. Sum the individual ranges and divide by the number of groups of five packages in order to determine the average range and record in box 21.

For example, with a sample size of 30, six groups of five packages will be listed in six columns in the crosshatched area. (See Figure 2-5.)



PACKAGE ERRORS										TOTALS (−)	TOTALS (0/+)
2	1	2	2	3	3					5	8
0	0	0	1	3	1					3	2
1	1	2	1	4	0					7	2
2	1	1	1	3	1					7	2
3	0	1	2	4	1					5	6
RANGES 5	1	3	1	1	4					15 TOTAL ERROR −7	

18 AVERAGE ERROR (Dimensionless Units)
15 ÷ 6 = −.23

21 AVERAGE RANGE
$\frac{15}{6}$ = 2.5

Figure 2-5. Example of package errors, ranges, and total error recorded on part of the report form.

2.10. THE CRITERIA FOR WEIGHING PACKAGES NOT LABELED BY WEIGHT

The preferred method for testing packages labeled in units other than weight is to weigh such packages. If the official can determine the weight of the labeled quantity of product, that weight plus the empty container weight can be used to compare with the weights of unopened packages. Otherwise, the official must open and measure the contents of every package in the sample -- a time-consuming and costly alternative.

However, two criteria must be met before the official may use a weighing technique:

(i) The equipment used must be able to discriminate differences in package content weights corresponding to the MAV/6.

(Most common liquid commodities will meet this criterion; see step 1, footnote, in Section 4.4.)

If the equal-arm scales described in Section 3.1. are used, this criterion can be met if 1/2 the smallest scale division is equal to or smaller than MAV/6. If a digital-readout scale is used, the smallest increment in the readout must not be larger than the MAV/6.

(ii) The weight of a known quantity of product must not vary significantly from package to package. (See Section 4.4. for liquid volume, 5.1.3. for count, 5.3.2. for linear measure.)

Chapters 4 and 5 describe in detail the procedures necessary to determine whether weighing can be used to determine net contents conformance for packages labeled in units other than weight (See Chapter 4 for volume and Chapter 5 for length, area, and count).

2.11. TARE

In compliance testing of packaged goods, the enforcement agency utilizes nondestructive tests insofar as possible, that is, testing that requires opening the fewest packages. The net weight of a package may be determined by weighing the unopened package - called the "gross weight" - and subtracting from that weight the average weight of the packaging materials, called the "average tare weight", provided that the actual tare weights of individual packages do not vary too much (see Section 2.11.4.). In more complicated situations, the official first determines whether the labeled unit of measure, if it is not weight (e.g., volume), can be converted to a weight value (using the measured weight of a known volume, in the example of volume). If this is possible, the net contents of a package can be found by subtracting the tare weight from the gross weight (and converting the resultant value from units of weight to the units on the package label).[1]

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[1] In actual practice, a "nominal gross weight" value will be determined (and recorded in box 14 of the report form shown on page A-1). The "nominal gross weight" is the sum of the average tare weight and the labeled weight. This weight value may then be easily compared with the actual gross weight of each unopened package in order to arrive at the individual package errors. For example, see steps 5 and 6 of Section 3.5.

The packages that are used to determine the average tare weight constitute the "tare sample". At least two determinations of individual package tare weights should be used to obtain an average tare value (that is, the tare sample size should be at least 2). For larger package sample sizes, the average tare value should be obtained from more than two determinations. (See Tables 2-2 and 2-5, pages B-3 and B-5, column 3, for tare sample sizes corresponding to various sample sizes.)

The average tare is recorded in box 13 on the report form on page A-1.

Two tare definitions are used commonly for the inspection of packaged goods:

- Dry tare comprises all packaging materials (including glue, labels, ties, etc.) that will contain or enclose a product; it includes prizes, gifts, coupons, or decorations that are not part of the product. Dry tare is measured before the product is introduced into the container. Dry tare is unused tare.

- Wet tare comprises all packaging materials that can be separated from the packaged product, whether readily (e.g., by shaking) or by washing, scraping, ambient air drying, or other techniques involving more than "normal" household recovery procedures, but not including laboratory procedures such as oven drying. As in the dry tare definition, prizes, decorations and such are also part of the wet tare. Wet tare is used tare.

In some cases (e.g., canned or glass- or plastic-packed goods) dry tare weights are equivalent to wet tare (within the measurement precision of field test scales). However, the net contents value that is obtained when a dry tare weight is subtracted from the package's gross weight will not always represent the amount of product that can subsequently be recovered from the package. For example, oils or moisture from the product may be absorbed by the packaging material when in contact with the product thereby increasing the weight of the packaging material and decreasing the weight of the product after packaging.

Tare weight can vary considerably from package to package as compared with the variability of the package net contents, even for packages in the same production lot. Although this is not the situation for most packaged products, it is a major problem with glass or aerosol containers. Therefore, an "alternative tare determination" procedure is provided in Section 2.11.4. This procedure must be used for glass or aerosol containers and is optional for any other container. There are several instances in which this procedure will prove useful to the official; the method is so simple that it can be used routinely. For example, relatively heavy containers (e.g., plastic buckets or cans) can vary considerably in tare weight, especially in a retail store inspection lot, which may be composed of packages from more than one production facility, and with containers made of different materials or made by different manufacturers. The procedure of Section 2.11.4. will indicate if this tare variability is sizable in comparison with the net weight variability, and whether the official should open more packages to obtain the average tare weight.

Direct measurement of net contents is necessary when the product cannot be checked by weighing. (For example, packaging materials and individual units in packages labeled by "count" sometimes differ enough in weight from each other such that the gross weight of a package minus the tare weight may not adequately indicate the count of units inside the package.)

The direct measurement of net contents is also necessary when the net content is defined as the "drained weight" of product inside the package. "Drained weight" is prescribed by regulatory agencies in those instances in which it has been concluded that the only usable or consumable material inside the package is the solid portion, whereas the liquid portion is disposed of and therefore "drained away". Common examples are canned or bottled olives and mushrooms. The liquids in which they are packed are not considered part of the net contents. Drained weight procedures are provided in Sections 3.10. and 3.13.

2.11.1. Choosing Packages for Tare

The tare sample should be a random sample. Appendix E contains descriptions of random sample and random tare sample selection. The packages to be opened for tare are determined as part of the random number selection process that determines the whole sample.

Some jurisdictions traditionally have taken the lightest and heaviest packages with respect to their gross weights as the tare sample. We recommend against this approach since variations in gross weight can be due to variations in tare weight, net weight, or both.

If dry tare is used, Appendix E procedures should be used to select the tare sample from the lot or lots of tare material.

Tare values are determined by weighing the empty package materials.

2.11.2. Cleaning Tare Materials

The method used for cleaning packaging material for tare weight determination depends on the tare material and the product it contains. In general, a common sense approach should be followed in cleaning tare materials. A bread bag, for example, may be turned inside out to remove all crumbs.

Care should be taken in cleaning tare material such as metal cans with paper labels so that the labels are not wet with water or other solvent used to clean the container. The interior of the containers should be thoroughly dried with a clean dry cloth or air dried, whichever is the most practicable. Butter or bacon wrappers, for example, should be scraped and wiped clean but no effort should be made to extract product contents absorbed by the tare. Caulking compound tubes should be cut open and scraped and wiped. Solvent may be used if the package is foil-lined, but precautions should be taken to avoid wetting the outside of the tube with solvent. Packages containing oil-based products may require several detergent washes to remove the product from the container.

The above are just a few of the approaches that may be used to clean packaging materials prior to determination of the tare weight.

2.11.3. Tare Neither Glass nor Aerosol

Table 2-2 and Table 2-5 (pages B-3 and B-5) indicate in column 3 how many packages to open or how many tare units to select at random in order to determine the average tare. The tare sample size is recorded in box 4 of the report form on page A-1.

The weights of the individual tare units (after cleaning) are recorded on the report form in the spaces marked "b" (see Figure 2-2) and should be averaged and entered in box 13. This average tare weight plus the declared net weight (subtracting any corrections) is the "NOMINAL GROSS WEIGHT" (box 14). The gross weights of unopened packages in the sample are compared with the nominal gross weight to determine their individual package errors.

2.11.4. Alternative Tare Procedure[1]

The following procedure must be followed for glass or aerosol containers and is optional for all other packages. For example, it has been noted that the tare variability is large for the metal cans and plastic overcaps for ground coffee and products in large cans or plastic buckets. "F-Style" rectangular cans, of the type in which turpentine, mineral spirits, and similar products are packaged, are also good candidates for this procedure.

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[1] Modification of a procedure in "Determining Tare in Net Weight Acceptance Sampling" by Robert S. Elder, Journal of Quality Technology, vol. 4, no. 3, July 1972, pp. 131-133.

It often will be necessary to follow the tare procedures below for checking random pack meat and poultry using wet tare determinations.

The total number of packages to be opened for tare is determined by first

- selecting the appropriate number of packages according to Table 2-6 (page B-6) for the "initial tare sample",
- determining their tare weights and net contents,
- obtaining the ratio of the range of net contents to the range of tare weights, and
- referring to Table 2-7 (pages B-7 and B-8), which shows the total number of containers to be opened.

The total number of packages to be opened for tare may or may not be greater than the initial tare sample size. The report form on page A-1 may be used for recording measurements for standard pack packages labeled by weight. (See Figure 2-2.) The detailed procedure is as follows:

(i) An "initial tare sample" (see Table 2-6, page B-6) is selected from the sample. (See Appendix E for a description of random sample selection.) The initial tare sample size is recorded in box 7 on the report form.

(ii) The packages chosen for tare are gross weighed, and then emptied.[1] Glass packages may be opened; aerosol packages must not be opened. (See Section 3.11.4. for instructions on emptying aerosol packages.)

(iii) The tare weight is determined and recorded for each package.

(iv) The net weights for the initial tare sample are calculated and recorded.

Net Weight = Gross Weight - Tare Weight

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[1] For packages labeled in units other than weight, a determination is made of the suitability of using a weight value in place of the labeled measure. This determination is made by using the contents of the first two packages chosen for tare determination, and is described in Section 4.4. for packages labeled by volume, in Section 5.1.3. for packages labeled by count, and in Section 5.3.2. for packages labeled by linear or area measure. The alternative tare procedure is then followed for those packages that can be checked by weight. For packages that cannot be checked by weight, net contents must be measured directly for all the sample packages and there is no tare determination.

(v) The "range of net weights" for the tare sample (R_c) is determined and recorded in box 9. (The range is the difference between the largest net weight value and the smallest. See Appendix H for more complete instructions on determining the range.)

(vi) The "range of tare weights" (called R_t) is determined and recorded in box 10.

(vii) The ratio R_c/R_t is computed and recorded in box 11. (R_c and R_t must both be in the same unit of measure or both in dimensionless units.)

(viii) The total number of packages to be emptied for the tare determination, n_t, is read from Table 2-7 (pages B-7 and B-8) and recorded in box 12. In this look-up table, read down the first column (headed R_c/R_t) to find the range in which the computed R_c/R_t fits, then read across to the column headed with the appropriate sample size, n. If the number of packages to open, n_t, is equal to the number already opened, no additional packages need to be emptied.

(ix) If n_t is greater than the number of packages already opened, compute the number of additional packages, equal to (n_t minus the initial tare sample size), which must be emptied.

For example, if R_c/R_t is 2.90 for a sample size of n = 30, 10 package tare weights are necessary to determine the average tare. In this example, if five packages have already been emptied, five more must be emptied to obtain an average tare value.

In another example, ten packages are randomly selected from an inspection lot of bottled herring labeled 4 oz. Their gross weights are:

0.406 lb*
0.400 lb*
0.404 lb
0.398 lb
0.408 lb
0.400 lb
0.394 lb
0.398 lb
0.396 lb
0.398 lb

The starred values are for the packages that were chosen for tare determination. The tare weights are: 0.146 lb for the first package and 0.150 lb for the second.

The range of tare weights, is R_t = 0.150 - 0.146 = 0.004 lb.

The package net weights for the two packages chosen for tare determination are:

0.406 lb - 0.146 lb = 0.260 lb
0.400 lb - 0.150 lb = 0.250 lb

The range of net weights, R_c = 0.260 - 0.250 = 0.010 lb.

R_c/R_t = 0.010/0.004 = 2.5. Consulting Table 2-7, for R_c/R_t = 2.5 and n = 10, n_t = 4; therefore, two more packages must be opened to determine the average tare.

(x) Steps (ii), (iii), and (iv) are repeated for these additional packages.

(xi) The average of all the tare weights is used together with the labeled quantity (in terms of weight) to represent the "nominal gross weight" (unless all the packages in the sample have been opened). The average tare weight is recorded in box 13 of the report form.

The actual package gross weights are compared with the nominal gross weight in box 14 to determine the package errors for all packages in the sample (see Chapters 3, 4, and 5).

If the number of packages required to be opened for tare is more than half of the total sample, the official has the option of opening all the packages in the sample. The tare values are not averaged in such instances. Instead, each tare weight is subtracted from the corresponding package gross weight to obtain the individual package net weight. It will be necessary to append worksheets to the report form if more than 5 packages must be opened.

Note: For foam product aerosols, a "test allowance" is applied to the tare determination to compensate for differences in product delivery between normal consumer usage and the test procedure. (See Section 3.11.6.) This test allowance (provided in Table 3-2, page B-17) is subtracted from the actual tare weight or the average tare weight. The test allowance is recorded in box 13a. See also Section 3.15. for corrections (box 13a) for canned coffee (vacuum pack). Moisture allowances can also be applied by means of a correction to the tare (and entered in box 13a).

2.12. MAV's

The limits of reasonable individual package variations are called "MAV's" in this handbook. The MAV applies only to individual packages subject to the average requirement. Pressed and blown glass tumblers and stemware given an "allowable difference" (see Section 5.7.) are not compared with the MAV.

In the past, limits of reasonable variation have been described as values limiting both positive and negative deviations from the label. The present handbook provides MAV's that are used to compare with minus package errors only[1]. Positive deviations will in general be controlled by the competitive marketplace; this handbook, therefore, indicates MAV values that are intended to limit only negative deviations from the labeled quantity.

Tables 2-8 through 2-11, on pages B-9 through B-14, are separated according to the labeled unit of measure, for example, weight, volume, etc.

In each table, one column lists ranges of labeled quantities and another column lists the MAV for that range. For example, the MAV for a labeled weight of 5 lb can be found on page B-10. 5 lb is in the range "4.70+ to 5.80"; the MAV in decimal pounds is 0.14 and in ounces is 2 1/4.

When an MAV is listed as a percentage of the label, make the calculation and round down to the lower figure equivalent to the unit of measure.

The MAV's for packages labeled by weight are limits to be applied to packages when the principal declaration on the label is in terms of net weight (e.g., soap) or drained weight (e.g., mushrooms). The MAV for packages labeled by weight do not apply to supplemental weight statements, such as "fill weight".

When checking standard pack packages, the official should complete box 3 of the report form on page A-1 using that value from Table 2-8, 2-9, 2-10, or 2-11 corresponding to the labeled quantity.

The special report form developed for random packages on pages A-3 and A-4 provides space for recording the MAV for random pack package weights. (See Section 3.8. for application of the MAV to random pack package lots.) Special worksheets provide space for calculating the MAV in units of weight and in dimensionless units for those instances in which weighing will be used to check packages labeled in units other than weight.

---

[1] Note exception in Section 2.13. for textiles.

2.13. EXCEPTIONS TO THE MAV's

When packaging practices or the nature of the product demands, MAV's exceeding those listed in Tables 2-8 through 2-11 are necessary.

Specific Product Exceptions to the MAV:

- Any individual thickness measurement of polyethylene sheeting may be as much as -20% below the labeled thickness (i.e., -20% of the labeled thickness).[1]

  The average thickness of a single package of polyethylene sheeting may be as much as -7% below the labeled thickness (i.e., -7% of the labeled thickness).[2] (See Section 5.4.3.)

- The National Conference on Weights and Measures Uniform Packaging and Labeling Regulation lists the MAV's for textiles[3] as the following:

  For those packages with no declared dimension less than 24 inches (60 cm):

  > A minus error may be no greater than -3% of a declared dimension;
  >
  > A plus error may be no greater than +6% of a declared dimension.

  For the packages with any declared dimension less than 24 inches (60 cm):

  > A minus error may be no greater than -6% of a declared dimension;
  >
  > A plus error may be no greater than +12% of a declared dimension.

- The National Conference on Weights and Measures recommends the following MAV for bark mulch.[4]

  > A minus error may be no greater than -5% of the declared volume.

---

[1] ASTM Standard D-4397-84, "Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications", 1984.

[2] 1978 Communication from the National Flexible Packaging Association (now the Flexible Packaging Association.)

[3] Section 10.9.3. of the Uniform Packaging and Labeling Regulation, NBS Handbook 130, 1984, "Uniform Laws and Regulations."

[4] Section 10.11. of the Uniform Packaging and Labeling Regulation, NBS Handbook 130, 1984, "Uniform Laws and Regulations."

- The Meat and Poultry Inspection Manual[1] of the U.S. Department of Agriculture (USDA) sets the lower limit for individual packages for meat and poultry that are produced under official USDA inspection. These are the limits applied by USDA inspectors at the production plant. These limits are defined according to the package's "group" and the scale division size being used by the packager. Table 2-12 on page B-15 defines the groups and the lower limits for individual packages. Only one in 40 packages is permitted to exceed the limits specified in Table 2-12 for groups A, 1, 2, 3, and 4. No package in a sample of 10 may exceed the limits specified for group 5.

2.14. MOISTURE ALLOWANCE

In those cases requiring allowance for moisture loss, one possible procedure is to subtract an allowance value (converted to units of weight if necessary) from the nominal gross weight (see Section 2.11. and Section 3.5.) to obtain a "corrected nominal gross weight". The gross weight of each unopened package in the sample is then compared with the corrected nominal gross weight in order to determine individual package errors.

The report form on page A-1 provides space in box 13a to record a moisture allowance in order to determine a corrected nominal gross weight (box 14). (See Figure 2-2.) This handbook does not provide specific allowance values to be used for moisture loss.

Other procedures or approaches to moisture loss may be used.

---

[1] See Appendix J for Subpart 18-K, "Net Weight", pp. 168—174, from the combined changes through December 1981, U.S. Department of Agriculture, Food Safety and Inspection Service, Meat and Poultry Inspection Program.

CHAPTER 3. METHODS OF TEST FOR PACKAGES LABELED BY WEIGHT

3.1. Weighing equipment

3.2. Preparation for testing

3.3. Recording package weights

3.4. Reading the package testing scale

3.5. Standard pack labeled by weight: CORE METHOD (dry tare)

3.6. Standard pack labeled by weight: wet tare

3.7. Standard pack labeled by weight: alternative tare

3.8. Random pack labeled by weight

3.9. Large packages and the substitution method

3.10. The determination of drained weight

3.11. Aerosol packages

3.12. Frozen food and other frozen products

3.13. Drained weight of frozen foods

3.14. Glazed raw seafood and fish

3.15. Canned coffee

CHAPTER 3. METHODS OF TEST FOR PACKAGES LABELED BY WEIGHT

This chapter describes weighing equipment and conventions in weighing. There follows a step-by-step description of the general method of test for packages labeled by weight (CORE METHOD) that will be referenced throughout the rest of the handbook. Variations on this core method are presented for wet tare, alternative tare, and random pack.

Methods of test for packages with large net weights, for specific types of commodities labeled by weight (drained weight, aerosols), and for other specific commodities (coffee, seafood) complete the chapter.

3.1. WEIGHING EQUIPMENT

Either mechanical or electronic digital scales may be used for checking packages labeled by weight. The mechanical equal-arm scales described below have been specially designed for package testing; available electronic equipment can equal or exceed the performance of these mechanical devices and is described in more general terms on page 3-3.

Equal-Arm Scale (for small weights in avoirdupois units) (Figure 3-1). - An equal-arm scale with approximately 5 pounds capacity and with center tower and poise beams is acceptable. The division size should not be greater than 1/16 oz on one face and 0.002 lb on the other face. There should be at least 10 divisions on each side of zero on both tower faces. The poise beams should have a zero notch in the center and notched divisions, each equal to or less than the tower capacity, on each side of zero with a span of at least 4 oz or 0.24 lb. For example, a scale with 20 divisions (of 0.002 lb each) on the tower face should have notched divisions of 0.04 lb intervals on the poise beams. (See the close up of a typical tower face in Figure 3-2.) The scale should be fitted with a locking device to hold the lever during transit, have a carrying handle, and should be provided with a protective cover or box. The sensitivity of this scale must meet section T.N.6.1.(b) of the Scale Code in NBS Handbook 44 (H-44). The accuracy should meet the acceptance tolerances given in H-44 Scale Code for Class II or Class III scales.

Equal-Arm Scale (for small weights in metric units).[1] - Similar in design to the avoirdupois weight scale, except that the maximum size of each tower division should be 1 g and the poise beam should be provided with at least a 200-g span with notched divisions each equal to or less than the tower capacity. The sensitivity of this scale must meet the requirements in T.N.6.1.(b) of the Scale Code, H-44. The scale accuracy should meet the acceptance tolerances given in H-44 Scale Code for Class II or Class III scales.

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[1] The markings specified for the equivalent metric scale may be incorporated into the present avoirdupois weight scales to eliminate the need for two scales.

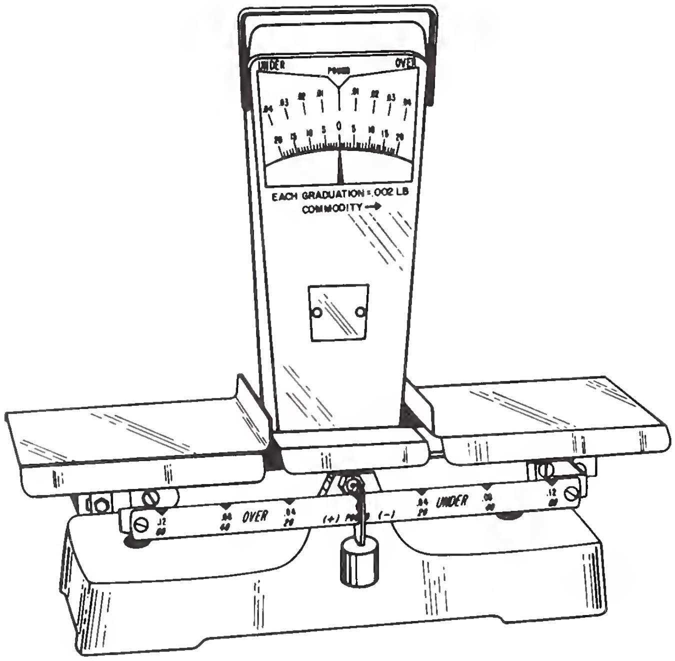
UNDER
POUND
OVER
EACH GRADUATION = .002 LB
COMMODITY →
OVER
(+)
(−)
UNDER

Figure 3-1. Equal-arm package testing scale for small weights (avoirdupois units).

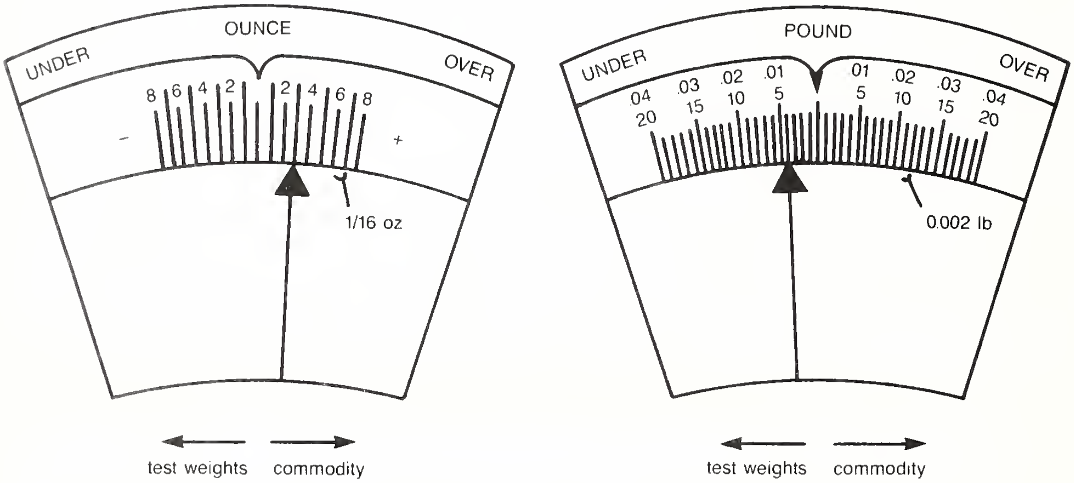
OUNCE
UNDER
OVER
8
6
4
2
2
4
6
8
−
+
1/16 oz
test weights
commodity
POUND
UNDER
OVER
.04
20
.03
15
.02
10
.01
5
.01
5
.02
10
.03
15
.04
20
0.002 lb
test weights
commodity

Figure 3-2. Mechanical package testing scale tower faces.

Equal-Arm Scale (for larger weights in avoirdupois units). - For checking relatively heavy packages, an equal-arm scale with center tower and poise beams and a capacity of approximately 20 pounds is acceptable. One face of the tower should have a maximum division size of 1/8 oz and the other face of the tower should show divisions not greater than 0.004 lb. There should be at least 10 divisions on each side of zero on both tower faces. The poise beams should have a zero notch in the center and notched divisions, each equal to or less than the tower capacity, on each side of zero. One beam should have at least a 12-oz span and the other side at least a 0.6-lb span. This scale, too, should be fitted with a locking device to hold the lever during transit, a handle for carrying, and should have a protective cover or box. The sensitivity must meet H-44 requirements (Section T.N.6.1.(b) of the Scale Code.) The accuracy should meet the acceptance tolerances for Class II or Class III scales.

Equal-Arm Scale (for larger weights in metric units).[1] - Similar in design to the 20 pound scale, except that the tower should have maximum divisions of 2 g and the poise beam should be provided with at least a 400-g span with notched divisions each equal to or less than the tower capacity. The sensitivity of this scale must meet H-44 requirements (Section T.N.6.1.(b) of the Scale Code.) The accuracy should meet the acceptance tolerances for a Class II or Class III scale.

Electronic Digital Scale. - Electronic digital scales appropriate for package testing are available with displays ranging from 0.0001 lb to 0.01 lb and capacities from 6 to 50 lb (or greater). The keys to selecting appropriate equipment for package testing purposes are:

- The scale should be selected such that the division size should be no greater than MAV/6 for the size package being weighed.
- The scale must meet all requirements of H-44 Scale Code.
  - The scale must meet the acceptance tolerances given in the Handbook for its class.
  - The scale must meet Section T.N.7.2., H-44, on discrimination.
- The scale must be portable and rugged.
- Slight out-of-level conditions should not introduce errors.
- For the convenience of the inspector (although not mandatory), the scale should be battery powered.

---

[1] The markings specified for the equivalent metric scale may be incorporated into the avoirdupois weight scales in order to eliminate the need for two scales.

Commercial Scale - If packages are heavier than the capacity of the equal-arm scale for larger weights, or if they cannot be accommodated on the platform of the equal-arm scale, it may be necessary to use an on-site device. Care must be exercised to ensure that the device meets, and is used in accordance with the criteria listed under the "substitution" method, discussed in Section 3.9.

Analytical Balance - Section 2.9.2. specifies the use of scales that can weigh accurately to 1/6 the MAV for an individual package. For example, the MAV for a 10-g package is 10% of 10 g or 1 g; therefore, the accuracy to be used in weighing is 1/6 g or 0.17 g, which cannot be attained by the small capacity equal-arm metric package scale. Electronic portable scales are capable of weighing to 0.1 g, but if they are not available to the inspector, very small packages must be weighed on an analytical balance. (This may require signing for and transporting packages to a laboratory.)

Field Standard Weights[1] (Figure 3-3) - Two kits in avoirdupois units are adequate for checking small packages labeled in inch-pound units. One is a collection of 31 pounds of standard weights from 2 lb to 1/16 oz denominations, the second kit's weights range from 0.3 lb to 0.001 lb. An additional 25-lb and two 50-lb standard weights will suffice to weigh most large packages.

For weighing packages labeled in metric units, weights should total 15 kg in standard weights of various denominations ranging down to 0.5 g for checking small packages. In addition, two 10-kg and two 20-kg standard weights will be sufficient to weigh most large metric packages.

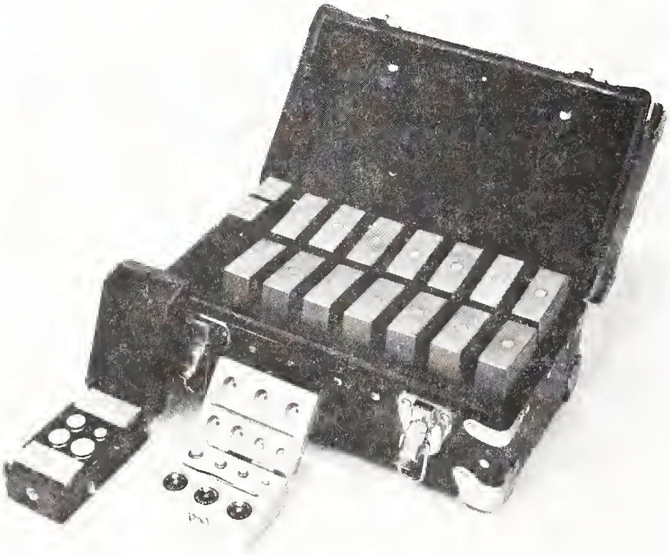

Figure 3-3. Test weight kit.

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[1] Tolerances for field standard weights (avoirdupois and metric) are given in Appendix I, Table I-1.

3.2. PREPARATION FOR TESTING

The principal requirement for a testing location is convenience to both the official and store, warehouse, or plant personnel. Any checking in the customer area of the store should be so located that it does not interfere with normal customer traffic.

Once the test area has been selected, provision should be made for a stable and level table or work area for the test equipment. (A bubble level may be used to verify level working surface.) The scale should be placed on a firm support and leveled. The official should

- check the scale accuracy and repeatability at zero-load indication and at 1/2 and full capacity,
- test the scale with small loads at zero and full capacity to determine the sensitivity of the indications (tower face, poise beam) or discrimination of the digital readout,
- perform a "shift test"[1] at 1/2 capacity.

A commercial scale may be used only after determining that it has met H-44 requirements and is sufficiently sensitive to indicate changes in weight commensurate with MAV/6 (see Section 2.9.2.). If selected, the scale should not be released to commercial service until the testing has been completed.

3.3. RECORDING PACKAGE WEIGHTS

Table 3-1 (page B-16) lists the recommended maximum units of measure with which the official should record weights according to the labeled weight of the package. This table gives guidance on appropriate equipment for different labeled weight declarations.

3.4. READING THE PACKAGE TESTING SCALE

To obtain the greatest accuracy with an equal-arm package testing scale, rather than reading the tower face directly to determine the package errors, the scale should be used as a "null-indicator". In order to use the scale as a "null-indicator", field standard weights are placed on one weigh pan to exactly balance the other weigh pan supporting the item to be weighed. The package errors may then be determined exactly as the sum of the reference weights added or subtracted (rather than weight indications on the tower face).

---

[1] For a discussion of the shift test, see pages 103-105 of NBS Handbook 94.

If an exact balance cannot be achieved when determining the gross or net weights and using the package checking scale as a "null indicator", the index of the indicator should point away from the product being weighed and toward material being weighed for tare.

If the package checking scale is read directly, it will frequently be necessary to round off the indication shown on the tower face to the nearest division (or to the nearest division corresponding to the increments in Table 3-1.). When the index of the package scale indicator is less than one half the distance between two divisions, the official should record the value corresponding to the lower division. Similarly, when greater than one half the distance, record the value corresponding to the next higher division. When the indicator is half way between two divisions, the official should record the value corresponding to the next higher division when recording the gross package weight, but should record the value corresponding to the next lower division when recording the tare.

Conventionally, neither packagers nor testing officials make air buoyancy corrections in the determination of package weights. For reasons of practicality, this handbook does not recommend or include air buoyancy corrections.

3.5. STANDARD PACK LABELED BY WEIGHT: CORE METHOD (DRY TARE)

The description below references numbered boxes on the report form on page A-1. (See Appendix A.) Other report forms and worksheets are provided in Appendix A for special procedures, to be discussed in later sections of this or other chapters, but are not mentioned in the description of the CORE METHOD.

An outline of the test procedure is provided in Figure 3-4.

The steps described in detail below should be followed when testing standard pack packages labeled by weight if dry tare is available:

1. Fill out the report form identifying the product, container description, location of test, and other pertinent data, including
   - the labeled weight (box 1),
   - the unit of measure[1] (box 2),
   - the MAV[2] corresponding to the labeled weight (box 3), and
   - the MAV converted to dimensionless units[1] (box 4). The value in box 4 is obtained by dividing the value in box 3 (the MAV in units of weight) by the value in box 2 (the unit of measure).

---

[1] The unit of measure most often chosen is the size of the scale division. See discussion in Sections 2.9.1. and 2.9.2. on the unit of measure and dimensionless units.

[2] Look up the MAV corresponding to the labeled weight in Table 2-8, pages B-9 and B-10.

Determine the inspection lot size (box 5). Record the

- sample size (box 6),
- tare sample size (box 7), and
- the number of unreasonable errors (errors exceeding the MAV) allowed (box 8) following one of the sampling plans in Category A (page B-3) or Category B (page B-5).

2. Select a random sample from the inspection lot. (See Appendix E.)

   Select a random tare sample from the lot or lots of tare materials.

3. Determine tare weights for the tare sample and record these values on the report form in the spaces provided beside box b.

4. Average the tare weights determined from the tare sample and record in box 13. If moisture loss is a permitted variation for the particular packages under test and a moisture loss allowance is assigned, record the allowance in box 13a.

5. Determine and record the nominal gross weight in box 14.

   Nominal gross weight = labeled weight (box 1) + average tare weight (box 13) - tare correction (box 13a)

6. Compare the sample packages with the nominal gross weight.

   - Equal-arm device: Put field standard test weights equal to the nominal gross weight[1] on the left pan of the scale and put one sample package at a time on the right pan, recording each individual package error in the crosshatched area of report form. (See Section 2.9.3. on how to fill out this part of the report form.) Complete the first column with the first five package errors before proceeding with the next columns in sequence. (Do not fill out the form by going across the page.)

   - Electronic device: Put field standard test weights equal to the nominal gross weight[1] on the scale and "tare out" the nominal gross weight so that the digital display is "0". Remove weights, place sample packages on the scale one at a time, and record package errors in crosshatched area of report form.

---

[1] When no variability is observed between individual tare weights, it is acceptable to put field test weights equivalent to the labeled weight (minus any corrections) plus an actual tare on the balance.

FIGURE 3-4.

OUTLINE OF PACKAGE TEST

Standard Pack Packages Labeled by Weight

1. Fill in pertinent data on report form: what is being tested, UNIT OF MEASURE, MAV, INSPECTION LOT SIZE, SAMPLING PLAN information.
2. Select RANDOM SAMPLE and RANDOM TARE SAMPLE
3. Determine AVERAGE TARE WEIGHT
4. Determine NOMINAL GROSS WEIGHT (labeled weight + average tare weight)
5. Determine PACKAGE ERRORS by comparing sample packages with nominal gross weight
6. Determine UNREASONABLE ERRORS by comparing minus package errors with MAV

> If number of unreasonable errors is greater than allowed by sampling plan, inspection lot fails test. No further testing is necessary.

7. Determine AVERAGE PACKAGE ERROR.

> If average package error is zero or plus, inspection lot passes test. No further testing is necessary.
>
> If CATEGORY B plan is being used, and average package error is a minus value, inspection of lot fails test. No further testing is necessary.

8. If a CATEGORY A plan is being used and average package error is minus, determine T.

> If average minus package error is larger in magnitude (disregarding the sign) than T, inspection lot fails test. If average error is smaller, inspection lot passes.

7. Compare each minus package error to the MAV. Circle any minus package error that exceeds the MAV (i.e., an "unreasonable error"). Record the number of unreasonable errors in box 16.

8. Compare the number of unreasonable errors found in the sample (box 16) with the number of unreasonable errors allowed (recorded in box 8 according to the sampling plan being followed). If the number found is greater than the allowed number, the lot fails to comply with the test. No further testing is necessary. Record the results in box 17 (and box 28 if no further testing is performed).

9. If the number of unreasonable errors found is not greater than the allowed number, sum the individual package errors in the right hand portion of the crosshatched area, taking into account the plus errors and minus errors. Record the total error in box 15. If the total error (box 15) is zero or a positive number, the lot passes the test. Compute the average package error by dividing the total error in box 15 by the sample size recorded in box 6. Record the average package error in box 18. Compute the average error in terms of weight by multiplying the average error in dimensionless units (recorded in box 18) by the unit of measure (recorded in box 2). Record that value in box 19. When following a Category B sampling plan, if the total (and average) error are negative, the lot fails the test. Record results in box 20 and record the disposition of the lot in box 28.

10. When following a Category A sampling plan, if the total error is negative, "T" must be computed before a final decision on the lot can be made.

    In order to compute "T":

    - Record the range (R) of package errors of each group of five packages tested in the sample. Space is provided at the bottom of each column of five package errors to record the range. (See Figures 2-4 and 2-5.) See Appendix H on how to compute a "range".

    - Average the group ranges and record the average range, $\overline{R}$, in box 21. (For a sample of 30, there will be 6 ranges to sum and divide by 6; for a sample of 50, sum 10 ranges and divide by 10.)

- Determine "d":

  d = Table 2-3, column 2 value multiplied by $\bar{R}$.

  Look up the value in Table 2-3, column 2 (page B-3) corresponding to the sample size (already recorded in box 6) and record this value in box 22. Multiply the value in box 22 by the average range $\bar{R}$ in box 21 and record d in box 23.

- Compute percentage of lot tested. This is equal to the value in box 6 divided by the value in box 5 and multiplied by 100. Record the value in box 24. (For a sample size of 30 and a lot size of 300, this value is 10%.)

- Look up "f" in Table 2-4 (page B-4) corresponding to the percentage of lot sampled that was recorded in box 24. Record this value in box 25. (For 10% of the lot tested, f = .95.)

- Compute "T":

  T = d x f = the value in box 23 multiplied by the value in box 25.

  Record T in box 26.

11. Compare the magnitude of T (box 26) with the magnitude of the average error (box 18) (disregarding the fact that box 18 is a minus value.) If the average error is larger than T, the lot fails to conform to the package requirements. If the average error is smaller than T, the lot conforms. Record the results in box 27 and box 28.

3.6. STANDARD PACK LABELED BY WEIGHT: WET TARE

The CORE METHOD is followed except:

o The random tare sample is selected from the random sample (in step 2).

o Gross weights of tare sample packages are determined and recorded before opening (in step 3).

o Tare weights are determined by emptying, cleaning or wiping dry, then weighing all packaging materials from the tare sample (in step 3).

o Package errors are determined for the tare sample by subtraction, for the rest of the sample by comparison with the nominal gross weight.

The procedure is as follows. Differences from the CORE METHOD are underlined.

1. Fill out the report form identifying the product, container description, location of test, and other pertinent data, including
   - the labeled weight (box 1),
   - the unit of measure (box 2),
   - the MAV corresponding to the labeled weight (box 3), and
   - the MAV converted to dimensionless units (box 4). The value in box 4 is obtained by dividing the value in box 3 (the MAV in units of weight) by the value in box 2 (the unit of measure).

   Determine the inspection lot size (record in box 5). Record
   - the sample size (box 6),
   - tare sample size (box 7), and
   - the number of unreasonable errors allowed (box 8) following one of the sampling plans in Category A (page B-3) or Category B (page B-5).

2. From the inspection lot, select the random sample, and from it the random tare sample. (See Appendix E for sample selection techniques.)

3. Determine and record individual package gross weights for tare sample. (See Figure 3-5.) Record in boxes labeled a. Open, empty, and clean tare sample packaging materials, determine and record tare weights in boxes labeled b.

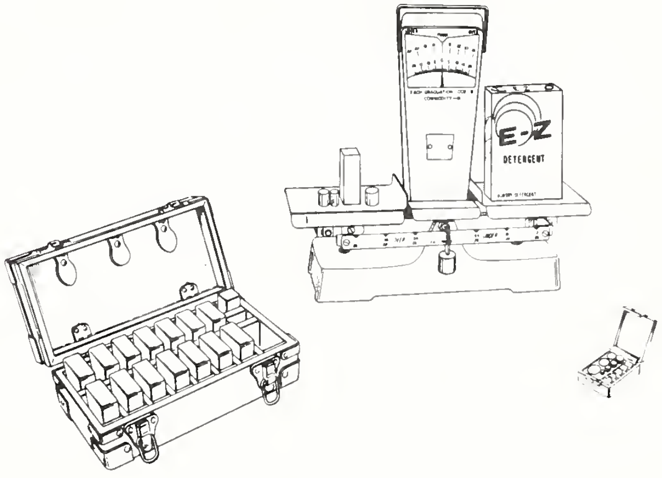

Figure 3-5. The determination of the gross weight of a package.

4. Average the tare weights determined from the tare sample and record in box 13. If moisture loss is a permitted variation for the particular packages under test and a moisture loss allowance is assigned, record the allowance in box 13a.

5. Determine and record the nominal gross weight in box 14.

   Nominal gross weight = labeled weight (box 1) + average tare weight (box 13) - tare correction (box 13a)

6. Compute and record package errors for tare sample:

   (a) Package error in units of weight = Gross weight of package - nominal gross weight. This is the value in box a minus the value in box 14. Record the results in boxes labeled d.

   (b) Convert package errors recorded in boxes d to dimensionless units (so that they can be recorded later in crosshatched area). Do this by dividing the package errors in units of weight (box d) by the unit of measure recorded in box 2. Record these values in the boxes labeled e.

   (c) Transfer package errors for tare sample recorded in boxes e to the crosshatched area of report form.

7. Compare unopened sample packages with nominal gross weight.

   - Equal-arm device: Put field standard test weights equal to the nominal gross weight[1] on the left pan of the scale and put one sample package at a time on the right pan, recording each individual package error in the crosshatched area of report form. Fill in the first column with the first five package errors before proceeding with the next columns in sequence. (Do not fill out the form by going across the page.)

   - Electronic device: Put field standard test weights equal to the nominal gross weight[1] on the scale and "tare out" the nominal gross weight so that digital display is "0". Remove weights, place sample packages on the scale one at a time, and record package errors in crosshatched area of report form.

8. Compare each minus package error to the MAV. Circle any minus package error that exceeds the MAV (i.e., an "unreasonable error"). Record the number of unreasonable errors in box 16.

---

[1] If no variability in the tare weights is observed in the tare sample, it is acceptable to put field test weights equivalent to the labeled weight (minus any corrections) plus an actual tare on the balance.

9. Compare the number of unreasonable errors found in the sample (box 16) with the number of unreasonable errors allowed (recorded in box 8 according to the sampling plan being followed). If the number of unreasonable errors found in the sample is greater than the allowed number, the lot fails to comply with the test. No further testing is necessary. Record the results in box 17 (and box 28 if no further testing is performed).

10. If the number of unreasonable errors found is not greater than the allowed number, sum the individual package errors in the right hand portion of the crosshatched area, taking into account the plus errors and minus errors. Record total error in box 15. If the total error (box 15) is zero or a positive number, the lot passes the test. Compute the average package error by dividing the total error in box 15 by the sample size recorded in box 6. Record the average package error in box 18. Compute the average error in terms of weight by multiplying the average error in dimensionless units (recorded in box 18) by the unit of measure (recorded in box 2). Record that value in box 19. When following a Category B sampling plan, if the total (and average) error is negative, the lot fails the test. Record results in box 20 and the disposition of the lot in box 28.

11. When following a Category A sampling plan, if the total error is negative, "T" must be computed before a final decision on the lot can be made.

    In order to compute "T":

    - Record the range (R) of package errors of each group of five packages tested in the sample. Space is provided at the bottom of each column of five package errors to record the range.

    - Average the group ranges and record the average range, $\overline{R}$, in box 21. (For a sample of 30, there will be 6 ranges to sum and divide by 6; for a sample of 50, sum 10 ranges and divide by 10.)

    - Determine "d":

      d = Table 2-3, column 2 value multiplied by $\overline{R}$

      Look up the value in Table 2-3, column 2 (page B-3) corresponding to the sample size (already recorded in box 6) and record this value in box 22. Multiply the value in box 22 by the average range in box 21 and record d in box 23.

- Compute the size of the sample as a percentage of the lot size. This is equal to the value in box 6 divided by the value in box 5 and multiplied by 100. Record the value in box 24. (For a sample size of 30 and a lot size of 300, this value is 10%.)

- Look up "f" in Table 2-4 (page B-4) corresponding to the percentage of lot sampled that was recorded in box 24. Record this value in box 25. (For 10% of the lot tested, f = .95.)

- Compute "T":

  T = d x f = the value in box 23 multiplied by the value in box 25.

  Record T in box 26.

12. Compare the magnitude of T (box 26) with the magnitude of the average error (box 18) (disregarding the fact that box 18 is a minus value). If the average error is larger than T, the lot fails to conform to the package requirements. If the average error is smaller than T, the lot conforms. Record the results in box 27 and box 28.

3.7. STANDARD PACK LABELED BY WEIGHT: ALTERNATIVE TARE

The CORE METHOD (page 3-6) is followed except:

- o The sample packages are kept in the order in which their corresponding random numbers were obtained.

- o The random tare sample is the "initial tare sample" and is selected from the random sample.

- o Tare weights are determined by emptying, cleaning, and weighing all packaging materials.

- o The range of tare weights (R_t) and range of net weights (R_c) is determined for the initial tare sample.

- o R_c/R_t is computed and this value is used to look up how many more packages (if any) must be opened to determine tare. Additional tare packages are measured as necessary.

- o Package errors are determined for the tare sample by subtraction, and for the rest of the sample by comparison with the nominal gross weight.

The procedure is as follows. Differences from the CORE METHOD are underlined.

1. Fill out the report form identifying the product, container description, location of test, and other pertinent data, including
   - the labeled weight (box 1),
   - the unit of measure (box 2),
   - the MAV corresponding to the labeled weight (box 3) and
   - the MAV converted to dimensionless units (box 4).

   Determine the inspection lot size (record in box 5). Record
   - sample size[1] (box 6) and
   - allowed number of unreasonable errors (box 8).

   Determine and record initial tare size from Table 2-6 (page B-6) in box 7.

2. Select random sample from inspection lot keeping sample packages in the order in which their corresponding random numbers are obtained. This is the order in which packages will be opened for tare determination. (See Appendix E.6.1. for an example.)

3. Determine and record individual package gross weights (in boxes labeled a) for initial tare sample.

4. Empty these packages, clean them, determine and record tare weights (in boxes labeled b).

5. Determine the range of tare weights (R_t). Record R_t in box 10. (See Appendix H on determining a "range.")

6. Subtract each tare weight from the corresponding gross weight to obtain the net weights for the initial tare sample. Record the net weights in the spaces labeled c.

7. Determine the range of net weights (R_c). Record in box 9.

8. Divide R_c (box 9) by R_t (box 10) and record in box 11.

9. Find the value recorded in box 11 for R_c/R_t in the left column of Table 2-7 (pages B-7 and B-8). Then read across to the column headed with the appropriate sample size. This value, n_t, is the total number of packages to be emptied for tare determination. Record this value in box 12. If the number in box 12 is equal to or less than the initial sample size (recorded in box 7), there are enough packages to determine the average tare. However, if the number in box 12 is greater than the value in box 7, more

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[1] For Category A, see page B-3. For Category B, see page B-5.

packages must be opened to determine average tare. For example, if 2 packages were opened initially and, using Table 2-7, n_t = 5 (in box 12), then three more packages must be opened to obtain an average tare value. In some instances, all the packages in the sample must be opened - an average tare is not appropriate. If more than 5 packages must be opened, the official will have to record the measurements on a worksheet.

10. Unless all packages in the sample have been opened, average the tare weights[1] and record in box 13. Go to step 11.

    If all packages have been opened,[2] each package error (in units of weight) =

    (gross weight) - (tare weight) - (labeled weight)

    Follow steps 12(b) and (c) and then skip to step 14.

11. Determine and record the nominal gross weight in box 14.

    Nominal gross weight = labeled weight (box 1) + average tare weight (box 13) - tare correction (box 13a)

12. Compute and record package errors for tare sample:

    (a) Package error in units of weight = Gross weight of package - nominal gross weight. This is the value in box a minus the value in box 14. Record the results in boxes labeled d.

    (b) Convert package errors recorded in boxes d to dimensionless units so that they can be recorded in crosshatched area. Do this by dividing the package errors in units of weight (box d) by the unit of measure recorded in box 2. Record these values in the boxes labeled e.

    (c) Transfer package errors for tare sample recorded in boxes e to the crosshatched area of report form.

---

[1] If moisture loss is a permitted variation for the particular packages under test and a moisture loss allowance is assigned, record allowance in box 13a.

[2] If all packages have been opened, then each package error must be corrected for moisture loss (if a moisture loss applies) before going to step 14.

13. Compare unopened sample packages with nominal gross weight.

    - Equal-arm device: Put field standard test weights equal to the nominal gross weight on the left pan of the scale and put one sample package at a time on the right pan, recording each individual package error in the crosshatched area of report form.

    - Electronic device: Put field standard test weights equal to the nominal gross weight on the scale and "tare out" the nominal gross weight so that the digital display is "0". Remove weights, place sample packages on the scale one at a time, record package errors in crosshatched area of report form.

14. Compare each minus package error to the MAV. Circle any minus package error that exceeds the MAV and record the number of "unreasonable errors" in box 16.

15. Compare the number of unreasonable errors found in the sample (box 16) with the number of unreasonable errors allowed (recorded in box 8 according to the sampling plan being followed). If the number of unreasonable errors found is greater than the allowed number, the lot fails to comply with the test. No further testing is necessary. Record the results in box 17 (and box 28 if no further testing is necessary).

16. If the number of unreasonable errors found is not greater than the allowed number, sum the individual package errors in the right hand portion of the crosshatched area, taking into account the plus errors and minus errors. Record total error in box 15. If the total error (box 15) is zero or a positive number, the lot passes the test. Compute the average package error by dividing the total error in box 15 by the sample size recorded in box 6. Record the average error in box 18. Compute the average error in terms of weight by multiplying the average error in dimensionless units (recorded in box 18) by the unit of measure (recorded in box 2). Record the value in box 19. When following a Category B sampling plan, if the total (and average) error is negative, the lot fails the test. Record results in box 20 and the final disposition of the lot in box 28.

17. When following a Category A sampling plan, if the total error is negative "T" must be computed before a final decision on the lot can be made.

In order to compute "T":

- Record the range (R) of package errors of each group of five packages tested in the sample. Space is provided at the bottom of each column of five package errors to record the range.

- Average the group ranges. Record the average range ($\bar{R}$) in box 21. (For a sample of 30, there will be 6 ranges to sum and divide by 6; for a sample of 50, sum 10 ranges and divide by 10.)

- Determine "d":

  d = Table 2-3, column 2 value multiplied by $\bar{R}$

  Look up the value in Table 2-3, column 2 (page B-3) corresponding to the sample size (already recorded in box 6) and record this value in box 22. Multiply the value in box 22 by the average range in box 21 and record d in box 23.

- Compute the size of the sample as a percentage of the lot size. This is equal to the value in box 6 divided by the value in box 5 and multiplied by 100. Record the value in box 24. (For a sample size of 30 and a lot size of 300, this value is 10%.)

- Look up "f" in Table 2-4 (page B-4) corresponding to the percentage of lot sampled that was recorded in box 24. Record this value in box 25. (For 10% of the lot tested, f = .95.)

- Compute "T":

  T = d x f = the value in box 23 multiplied by the value in box 25.

  Record T in box 26.

18. Compare the magnitude of T (box 26) with the magnitude of the average error (box 18) (disregarding the fact that box 18 is a minus value). If the average error is larger than T, the lot fails to conform to the package requirements. If the average error is smaller than T, the lot conforms. Record the results in box 27 and box 28.

3.8. RANDOM PACK LABELED BY WEIGHT

Random pack packages are those whose contents are measured, packaged, and labeled individually. These packages do not generally occur in fixed or patterned quantities. They occur most frequently labeled by weight. They are tested most frequently where packaged, usually at the retail store or wholesale warehouse.

See Section 2.3.2. for the definition of a lot for random pack commodities.

Special report forms, such as the ones on page A-3 and A-4, will simplify recording additional information (such as the product identity, unit price, and labeled weight) that many jurisdictions desire when testing random pack packages.

The methods for checking random pack packages are derived from the standard pack CORE METHOD for dry tare, wet tare, or alternative tare.

Section 3.8.1. describes the most common test procedure for random pack, using dry tare and a Category B sampling plan. Section 3.8.2. describes variations using "page 2" (see page A-4) of the report form for Category A plans, or wet tare, or alternative tare.

These random pack methods will be described after discussing the choice of the MAV.

Selecting the MAV

Table 2-8, pages B-9 and B-10, lists MAV's that vary with the labeled weight.

Because random pack packages are individually weighed and marked after packing, an additional element of control is possible that is not available with standard pack packages. Consequently, the amount of variability found in the package errors for random pack packages is frequently less than in standard pack.

This handbook therefore, recommends for audit testing:

- When testing inspection lots defined as a single size of tare (e.g., boat size "2S"), apply the MAV corresponding to the smallest labeled weight in the sample.

- When testing inspection lots defined as the entire meat case, or entire store-packed produce counter, etc., apply the MAV corresponding to the average labeled weight in the sample.

When official tests are performed, identify the appropriate MAV for each package labeled weight. When using dry tare, it is convenient to reorder the sample from lightest to heaviest in labeled weight prior to testing. This facilitates selecting MAV's according to labeled weight ranges.

3.8.1. Random Pack, Dry Tare, Category B Sampling Plans

The CORE METHOD should be followed, except:

- Labeled weight and MAV cannot be recorded until the sample has been selected.
- After the sample has been selected, reorder packages from lightest to heaviest to facilitate building the nominal gross weight from standard test weights (against which the packages will be compared).
- Variability of tare weights should be tested. However, the dry tare weight of many random pack packages varies less than the detection capability of the official's equipment. In these instances, a single dry tare, comprised of all the packaging materials (including the label), may be substituted for the field standard weights to represent the tare weight portion of the nominal gross weight.
- Report form box numbers on pages A-3 and A-4 differ from the standard pack form box numbers (page A-1).

The procedure is as follows. (Boxes on the report form, page A-3, are identified.) Differences from the CORE METHOD are underlined.

1. Begin to fill out the report form by identifying the location of test. Determine the size of the inspection lot to be tested (box 1). According to Table 2-5, page B-5, record the sample size (box 2), tare sample size (box 3) and number of unreasonable errors allowed (box 4). Record the unit of measure (box 5). Check the dry tare box under "Tare" on the right side of the report form.

2. Select random sample. (See Appendix E.) Have tare made up to represent tare sample. Note that when the tare is comprised of a foam or plastic boat, a fixed number of soaker pads, shrink wrap, and label, a single tare appropriate for each size of package can be the tare sample if no variation in tare weights is detected. If variability in tare weights is present, space is provided on the form for recording up to four different tare samples (corresponding, for example, to different tray sizes).

   Reorder sample packages in the order of their labeled weights and record product identity, lot code, price per unit of weight, and labeled weight (boxes 7 and 8).

For audit test, record MAV in box 10 corresponding to:

- smallest labeled weight when lot is defined as a single product or consists of a single tray size for tare; or
- average labeled weight when lot is defined as entire production of store department, e.g., meat department or produce department.

For official tests, record in box 10 the MAV corresponding to each package labeled weight.

Divide the MAV (box 10) by the unit of measure (box 5) to get the MAV in dimensionless units. Record this value in box 11.

3. Compare first sample package with its nominal gross weight. Nominal gross weight for each package is individual package labeled weight (which will vary from package to package) plus unused empty package tare (which may vary depending upon how the inspection lot is defined).[1]

    - Equal-arm device: Place empty dry tare package[1] plus field standard weights equal to the labeled weight marked on the first package on the left pan of the scale and place first sample package on the right pan. Record the package error (in dimensionless units) in the space provided in box 9, minus errors in column headed (-) and zero or plus errors in column headed (0/+).
    - Electronic device: Place actual dry tare[1] plus field standard weights equal to the labeled weight marked on the first package on the scale. "Tare out" this value so that the digital display is "0". Remove tare and weights. Place first sample package on the scale; record package error, as read, in space below box 9.

4. Compare remaining sample packages with their own nominal gross weights and record as described in step 3.

5. Circle minus package errors that are larger than the appropriate MAV recorded in box 11. Count circled (unreasonable) package errors. Record this number in box 13 at the bottom of the report form.

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[1] If variation in tare weights for a single tray size is noted, then nominal gross weight = (labeled weight) + (average tare weight).

6. If the number in box 13 is larger than zero (the number in box 4), check in box 14 that the lot fails and enter the final disposition of lot in box 18. No further testing is necessary.

   If the number in box 13 is zero, continue.

7. Taking account of plus and minus errors, sum package errors and record total error in box 12. Record average error in box 15.

8. Convert average error in dimensionless units to units of weight and record in box 16.

9. If average error is zero or plus, check that the lot passes in box 17.

10. In box 18, record results from boxes 14 and 17, either lot approved or rejected.

3.8.2. Random Pack, Wet Tare or Alternative Tare Methods, or Category A Sampling Plans

The second page of the Random Pack Report Form on page A-4 is provided for the several calculations that must be performed with these methods.

If the inspection lot is defined as the entire meat department, etc., the average tare weight must be determined for each and every type and size of tare in the sample.

Unlike the procedure for random pack using dry tare, the official should not reorder the packages in the order of their labeled weights. This will preserve the random order for the tare sample and for the determination of the range of package errors.

When determining wet tare weights for random pack packages of meat, poultry, fish and similar products, the official may note large variations in tare weights stemming from, for example, different numbers of soaker pads in packages, or different amounts of absorbed liquid in the packaging materials. In such case, the alternative tare procedure of Section 2.11.4. will be useful in the determination of the average tare weight. Use of the alternative tare procedure is described in the method on the next page.

Summary of wet tare, alternative tare, and/or Category A methods

Follow Section 3.6. (standard pack, wet tare) or 3.7. (standard pack, alternative tare) except:

- Nominal gross weight for each package is the individual package labeled weight (which will vary from package to package) plus the average tare.
- Report form box numbers differ from the standard pack form.

Procedure (alternative tare, Category A)

Although this procedure is based on the CORE METHOD, differences from the CORE METHOD are not underlined.

1. Select random sample and mark packages in the order in which the random numbers were obtained. This is the order in which the packages will be opened for tare and the order in which the package errors will be recorded. Record the package descriptions and labeled weights in this order in boxes 7 and 8 on "page 1" of the report form (shown on page A-3). Record the MAV corresponding to each labeled weight in box 10.

2. Determine and record in boxes labeled a and b on "page 2" (shown on page A-4) gross weights and tare weights of packages in the initial tare sample. (See Table 2-6, page B-6.) (For example, when the initial tare sample size is 5, packages marked "1" through "5" are gross weighed.)

3. Subtract each tare weight from its corresponding package gross weight to determine the net weights of the packages in the initial tare sample. Record in boxes labeled c on "page 2".

4. Determine and record the range of tare weights, R_t, for the initial tare sample and record this value in box 6b on page 2 of the report form. Determine and record the range of net weights, R_c, in box 6a. Compute R_c/R_t; record in box 6c. Look up the value for n_t, the number of packages needed to determine the average tare, in Table 2-7, pages B-7 and B-8, and record in box 6d. Open additional packages (in the order marked), if necessary, and record their gross and tare weights.

5. Unless all packages in the sample have been opened, average the tare weights, and record average tare in box 6e. Compute package errors for the packages opened for tare and record these package errors in boxes labeled d and e. Transfer these package errors to page 1, box 9, of the report form. If at least half of the packages in the sample are needed to determine the tare, open and determine the net weight (gross weight minus tare weight) and package errors (net weight minus labeled weight) for all the packages in the sample. Additional worksheets will have to be appended to the report form to show all the calculations. When all packages have been opened, go to step 7 to complete the test.

6. Rearrange any remaining (unopened) packages in the sample from lightest to heaviest in order to facilitate subsequent measurements. Compare each unopened package with the nominal gross weight comprised of test weights representing the average tare weight plus the individual package labeled weight. Record the package errors in the spaces below box 9 on the first page of the report form corresponding to the package number marked on the package. (As an example, after five packages were opened for tare, the package with the lightest labeled weight may have been marked number 27. The package error is determined and recorded on the 27th line in box 9 of the report form beside the product description and labeled weight for this package, already recorded in boxes 7 and 8.)

7. Circle those minus package errors that exceed the MAV. Record in box 19 (on the second page of the report form) whether the number of unreasonable errors (box 4) exceeds the allowed number (box 13). If so, the lot fails and no further testing is necessary.

8. If the number of unreasonable errors is less than or equal to the allowed number, compute the total package error and record this value in box 12 (on the first page of the report form). If the total error is a plus value, the lot complies with the requirements. Complete boxes 20 and 21 on "page 2" and check that the lot is accepted (box 18 on "page 1").

9. If the total error is a minus value, compute the range of package errors for each group of five packages and record this in the spaces provided in box 23, "page 2". Compute the average range in box 24. Look up the value corresponding to the lot size in Table 2-3, column 2 (page B-3) and record this value in box 25. Compute and record d in box 26. Compute the percentage of the lot that the sample represents in box 27. Look up f in Table 2-4 (page B-4) and record it in box 28. Compute and record T in box 29. Compare the average error in box 20 with T in box 29. Record the final disposition of the lot in box 18 on the first page of the report form.

3.9. LARGE PACKAGES AND THE SUBSTITUTION METHOD

The substitution method may be used with any commercial scale for the checking of large packages (random or standard pack) if the size and/or weight exceed the capacity of the equal-arm (or equivalent) package-checking scales. The commercial scale should be used only as a substitution weigher or as a null indicator, not as a "direct reading" device, because possible scale error and between-division interpolation error contribute to the uncertainty of results. When using a commercial scale, each weighing, whether gross weight or tare weight, will require the following steps. (See example in Figure 3-6.)

1. Place package on commercial scale and record scale reading. Remove package.

2. Place standard weights equivalent to the scale indication in step 1 on the scale and add a small amount of additional weights (an additional 1 to 3%) to obtain an exact scale reading such that:

   o If an analogue scale, the index of the indicator is coincident with a scale division.

   o If a digital scale, a "break-point" is attained between two consecutive indications. Add a sufficient amount of small weights (in increments equal to 1/10 the value of the scale's minimum division)[1] to reach break point.

   Record standard weights and scale reading on a worksheet.

3. Remove standard weights from the scale. Place the sample package on the commercial scale again.

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[1] For a discussion of error weights testing, see pages 120-122 of NBS Handbook 94.

Figure 3-6. Examples of substitution weighing.

Step		standard weights on pan	scale reading
		(decimal pounds)	
	Determining Gross Weight or Tare Weights		
1.	After placing sample package on scale pan		101.1
2.	After placing standard weights on pan to give an exact reading equal to step 1 scale indication + approximately 1 percent	101.94	102.0
3.	After removing standard weights and replacing sample package		101.1
4.	After adding standard weights to duplicate step 2 scale indication	0.93	102.0
	Gross weight = (standard weights, step 2 - step 4) = 101.01 lb		
	Determining Package Error When Tare Weight Is Known		
1b.	Scale reading with package on pan		101.1 lb
2b.	After placing standard weights on pan to give an exact reading equal to (tare wt + labeled wt + approximately 3% labeled wt	104.46 lb	104.5 lb
3b.	After removing standard weights equal to tare + labeled wt and adding sample package	3.11 lb	104.2 lb
4b.	After adding or removing* standard weights to duplicate step 2b scale indication	3.43 lb	104.5 lb
	Package error = (standard weights, steps 3b - step 4b) = -0.32 lb		

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* With an electronic digital scale, see instructions in step 4, p.3-27.

4. Add or subtract weights until the scale reading recorded in step 2 is duplicated. With an electronic digital scale, if weights must be removed, remove enough weights so the readout of step 2 is duplicated by adding (rather than removing) weights in weight increments of 0.1 division. (That is, always approach the break-point from the minus side of the weight indication.) Record on the worksheet the standard weights on the scale. The gross weight of the package is equal to the total of standard weights recorded in step 2 minus the total of standard weights recorded in this step.

5. Repeat steps 1 through 4 to determine the tare weight of the package and to determine the gross weights and tare weights of the remaining tare sample packages.

In the second example (labeled b in Figure 3-6), a sample package is compared to the nominal gross weight to determine the package error. If weights are added in step 4b, this indicates a minus package error; if weights are removed, this is a plus package error.[1]

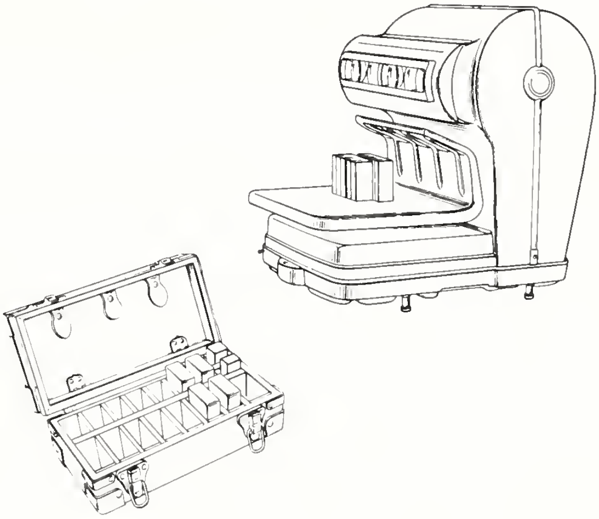

Figure 3-7. Standard weights on pan of commercial scale.

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[1] If a moisture loss is to be applied, package error is equal to weights added or removed plus (+) moisture allowance (converted to units of weight). For example, if moisture allowance of 2 lb is applied to example b, a package error of 2.00 lb - 0.32 lb = +1.68 lb results.

3.10. THE DETERMINATION OF DRAINED WEIGHT

Since the weight per unit volume of a drained product is of the same order of magnitude as that of the packaging liquid which is drained off, an "estimated gross weight" cannot be used in checking packages of this type. The entire sample must be opened. The procedure is based upon a test method accepted by the Food and Drug Administration.[1]

A tare sample is not needed because all the packages in the sample will be opened and measured.

The weight of the container plus drained-away liquid is determined. This weight is then subtracted from the gross weight to determine the package error.

3.10.1. Equipment

Scales and weights recommended in Section 3.1. are suitable for determinations of drained weight.

Sieves

- For drained weight of 3 lb (1.36 kg) or less, one 8-in (or 20-cm) No. 8 mesh U.S. Standard Sieve Series stainless steel sieve, receiving pan, and cover.
- For drained weight greater than 3 lb (1.36 kg), one 12-in (or 30-cm) sieve, with same specification as above.

Stopwatch - mechanical or electronic, with a maximum error of 2 seconds in a 3-hour period.

3.10.2. Procedure

1. Fill out boxes 1 through 8 on the standard pack report form. Select the random sample. Determine and record on a worksheet the weight of the receiving pan.
2. Determine and record on a worksheet the gross weight of each individual package comprising the sample.
3. Pour the contents of the first package into the dry sieve with the receiving pan beneath it, incline sieve to a 17-20° angle to facilitate drainage, and allow the product to drain into receiving pan for 2 minutes. (Do not shake or shift material on the sieve.) Remove sieve and product.

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[1] See Method 32.002 of the Official Methods of Analysis of the Association of Official Analytical Chemists.

4. Weigh the receiving pan, liquid, wet container, and any other tare material. (Do not include sieve and product.) (See Figure 3-8.) Record this weight as tare and receiving pan.

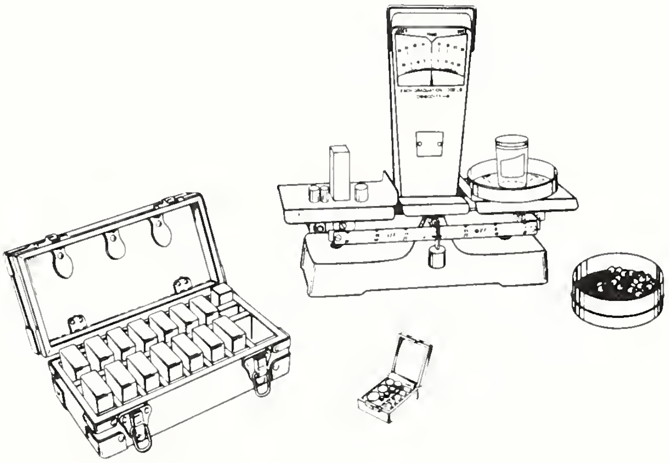

Figure 3-8. The determination of tare for packages labeled by drained weight (example: olives).

5. Subtract the weight of the receiving pan, determined in step 1, from the weight obtained in step 4 to obtain the tare weight (which includes the weight of the liquid).

6. Subtract the tare weight, found in step 5, from the appropriate package gross weight determined in step 2 to obtain the drained weight of that package. Determine the package error (drained weight - labeled weight).

7. Repeat steps 3 through 6 for the remaining packages in the sample, cleaning and drying the sieve and receiving pan between measurements of individual packages.

8. Transfer the individual package errors to the standard pack report form, page A-1.

9. Continue with steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

3.11. AEROSOL PACKAGES

The testing of aerosol packaged products is covered in the following sections. After a list of equipment (Section 3.11.1.) and a description of the assembly of a portable test stand used when emptying the containers (Section 3.11.2.), the details of the net contents determination are described in Sections 3.11.3. and 3.11.5. Methods for emptying the aerosol containers are given in Section 3.11.4. Test allowances to be applied to the average tare weight or individual tare weights of foam aerosols are given in Section 3.11.6.

3.11.1. Equipment

Scales and weights recommended in Section 3.1. are suitable for weight determinations.

Portable test stand with adjustable valve depressor; assembled from components available from a scientific supply company or hardware store. The components are:

- support stand,
- utility clamp,
- gasoline can,
- two dishpans, and
- 1/2-inch carriage bolt (either 2 to 3 in or 5 to 7 cm long) and nut.

3.11.2. Preparation for Test

To assemble the stand for foam and most other aerosol packages, thread the carriage bolt into the nut and use the jaws of the utility clamp to grip the nut tightly. Mount the clamp on the rod of the support stand. (See Figure 3-9.)

Adjust the height of the clamp to the height of the container under test and thread the carriage bolt to depress the aerosol valve until maximum flow of product is obtained.

Use the dishpans to collect the expelled product.

Add the support plate and gasoline can to the stand for aerosol products such as paints and coatings (as shown in Figure 3-10). Adjust the support plate so that the orifice of the spray can is lined up with the intake of the gasoline can. Leave the vent on the gasoline can open and clear. The clamp and valve-depression adjustment is made in the same manner as with the other aerosol products.

Unlike conventional standard-pack packages, aerosol packages must not be opened. Instructions on the container specifically state:

> Caution: Contents under pressure--do not puncture.
>
> WARNING: The containers of packaged aerosol products are under pressure and should not be punctured, broken, or subjected to temperatures in excess of 120 °F. The fumes and suspension of finely divided product may be toxic, irritating, and flammable.

Therefore, the exhausting procedure described in Section 3.11.4. should be conducted in a well ventilated area, in an exhaust hood, or outdoors, at least 50 feet from any source of open flame or spark. No smoking should be permitted in the test area.

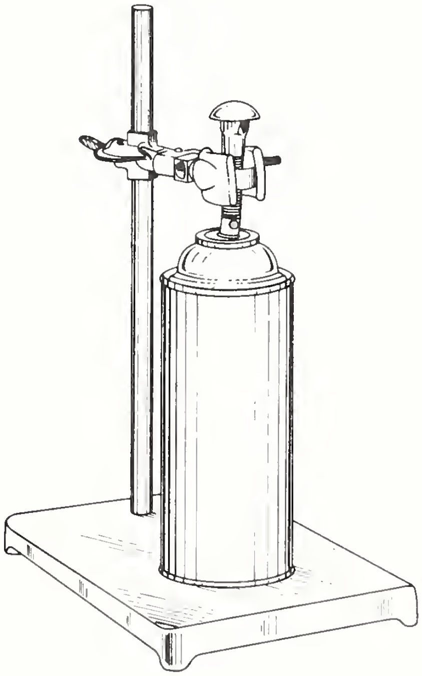

Figure 3-9. Portable test stand for all aerosol products except paints and coatings.

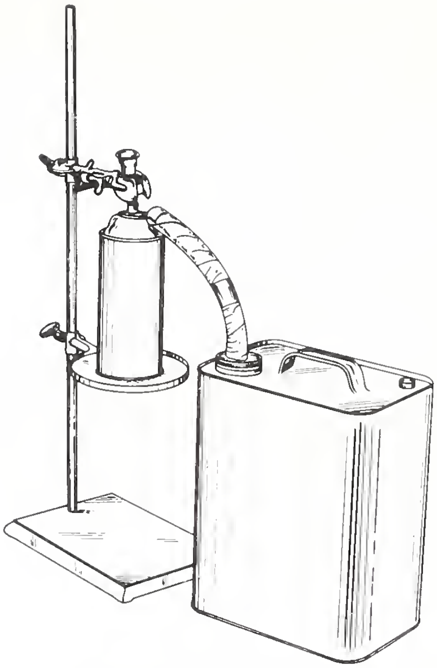

Figure 3-10. Portable test stand for aerosol paints and coatings.

Use the test stand equipped with the adjustable valve-button depressor for exhausting the container. Place the test stand in a plastic dishpan with another dishpan in an inverted position over the test stand to minimize pollution with the sprayed product during the exhausting procedure. Use the gasoline can as a receiving vessel for paint and coating products. (See Figure 3-10.)

3.11.3. The Determination of Net Contents: Part 1

All aerosol packaged products (except refrigerated products) should be checked at a product temperature of 68 °F (20 °C). All products that must be refrigerated to maintain quality should be checked at a product temperature of 40 °F (or 4 °C). Lower temperatures will require applications of a correction because less product will be expelled at lower temperatures. For practicality, testing at a 68 to 80 °F (or 20 to 27 °C) range is suggested for non-refrigerated products and 40 to 45 °F (or 4 to 7 °C) for refrigerated aerosols. These temperature ranges are representative of the temperatures at which the products are normally used.

Since it is not practicable to have a single test procedure covering every product or brand, the products are broken down into two general categories, each category having similar properties. The categories of aerosol packaged products are: (1) foam products and (2) other products. Examples of products in each of the two categories are listed in each section.

A test allowance is added to the delivered weight when testing products in the foam products category only.[1] The allowance compensates for differences in delivery between normal consumer usage and the exhausting procedure for compliance testing. Within the foam category, however, some products will deliver more completely than others. Thus, it is conceivable that a foam aerosol packaged product could deliver the stated quantity within the limits of the test allowance, and yet be short filled on a dry tare basis. It is emphasized that the test allowance should not be used by the packager as justification for packing less than the stated quantity on a dry tare basis.

Regulations under the Fair Packaging and Labeling Act[2] require that, in the case of packages designed to deliver the product under pressure, "...the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed."

The procedure presented below may be used for checking aerosol net contents when labeled by weight.

1. Fill out the heading of the standard pack report form (page A-1) and select the random sample. As explained in Appendix E.6.1., the random sample should be arranged in the order in which the random numbers were selected. This will be the order in which the packages will be opened for tare. Consult Table 2-6, page B-6, for the size of the initial tare sample.

2. Gross weigh each package in the initial tare sample and record this weight on the report form in the boxes labeled a. Follow Section 3.11.4. to empty the initial tare sample aerosol containers.

After following Sections 3.11.4., go on to Section 3.11.5. for instructions on completing the procedure.

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[1] In the testing procedure, the test allowance is subtracted from the nominal gross weight, the effect of which is the same as adding the test allowance to the delivered weight.

[2] Regulations under the Fair Packaging and Labeling Act (PL 89-755) include 16CFR§500.22(a), 21CFR§701.13(g)(1), 21CFR§201.62(f), and 21CFR§101.105(g). Also see parallel requirements recommended by the National Conference on Weights and Measures in its Uniform Packaging and Labeling Regulation (Section 10.3) in NBS Handbook 130. Quotations above from 21CFR§101.105(g).

3.11.4. Exhausting the Aerosol Container

Follow the procedures below to empty aerosol containers and thereafter determine their tare.

Do not shake unless shaking is specified. If shaking is specified, shake according to directions on the container. If no directions are given as to how the can should be shaken, shake the container with a brisk wrist-twisting motion for one minute at the approximate rate of two wrist-twisting cycles per second. If the container has a ball agitator, continue shaking procedure for one minute after the ball has shaken loose.

a. Foam products:[1] Placing the selected container in the position specified in the instructions on the package, exhaust it by holding the valve wide open for 30 minutes. (See Figures 3-11 and 3-12.)

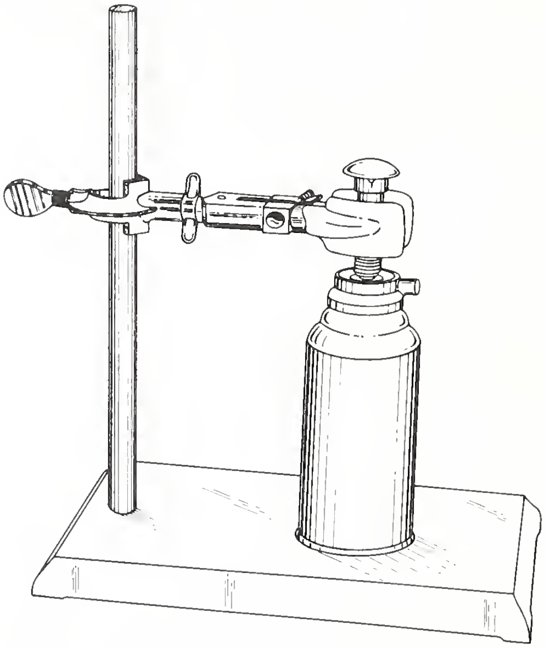

Figure 3-11. Portable test stand showing aerosol foam product ready to expel in upright position.

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[1] A foam product is defined as a product that forms a foam at the container valve or on impingement with a surface and the foam volume is not substantially reduced for at least 20 seconds. Examples of foam products: shave creams, hand creams, facial foams, shampoos, oven cleaners, upholstery cleaners, foam degreasers, whipped toppings, frosted whips.

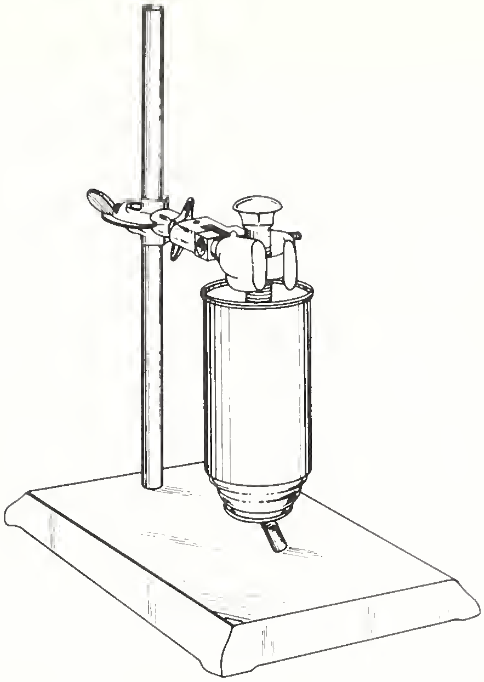

Figure 3-12. Portable test stand showing aerosol foam product ready to expel in inverted position.

b. Other products:[1] If shaking is specified in the instructions, shake at periodic intervals (at least two or three times during expulsion of the product). With the container in the position specified on the package, exhaust the sample container by depressing the valve-actuator until visible spray is interrupted. As soon as spray is interrupted release the actuator. (A change in sound usually accompanies spray interruption.) Allow the container to warm to 68 to 80 °F (20 to 27 °C) before concluding the evacuation.

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[1] Examples of other products: Frostings, syrups, cheese spread, hair sprays, colognes, window cleaners, starches and fabric finishes, insecticides, room deodorants, personal deodorants, waterproofers, antiseptics and medicants, de-icers, ignition sprays, insect repellants, furniture polishes, dog and pet sprays, oil sprays, battery cleaners, shoe polishes and leather conditioners, wall cleaners, suntan lotions, spray-on bandages, run-stoppers, pre-shave lotions, nasal relief sprays, external analgesics, charcoal lighters, fire extinguishers, anti-static sprays, carburetor cleaners, plant foods, auto quick-start sprays, whitewall tire cleaners, paints, enamels, lacquers, acrylic coatings, varnishes, undercoatings.

Agitate the container with a swirling motion for 30 seconds. Hold the container at an angle of approximately 45 degrees from the upright position, with the valve-actuator depressed, and rotate the container to maintain a visible spray (again, note the sound change) as long as possible. (Rotating will ensure contact of the dip tube with any remaining product in the container.) Continue this procedure until no additional product or gas is expelled. Any undelivered product should be expelled as completely as possible by holding the container in the hand with the valve-actuator depressed and alternately inverting the container and then restoring to the original test position at approximately 10-second intervals until no additional product is delivered.

When exhausting containers with vapor tap valves (in which product continues to be expelled upon inversion of container), stop the exhausting procedure whenever the container becomes cold to the hand. Allow the container to return to test temperature of 68 to 80 $^{\circ}$F (or 20 to 27 $^{\circ}$C) before continuing the test.

A container with a metered valve cannot be emptied by holding the valve-actuator depressed since such a valve permits only a predetermined amount of product to be expelled each time the valve-actuator is depressed. Empty the container by alternately depressing and releasing the valve-actuator until no additional product or gas is expelled.

3.11.5. The Determination of Net Contents: Part 2.

The following steps complete the procedures begun in 3.11.3:

3. Rinse the outside of the containers with a suitable solvent and dry the exteriors of the containers. If the valve-actuators are removable, remove for cleaning and drying, and then replace. Determine and record on the report form in the boxes labeled b the tare weights of the initial tare sample. Calculate the net weights for the initial tare sample and record in boxes labeled c. For foam product aerosols, each package net weight is equal to the package gross weight minus the individual tare weight plus the test allowance. (See Section 3.11.6.)

   For other aerosols, an individual package net weight is equal to the package gross weight minus the package tare weight.

4. Determine and record in box 9 on the report form the range of net weights, R_c.

5. Determine and record in box 10 the range of tare weights, R_t.

6. Compute R_c/R_t and record in box 11. From Table 2-7, pages B-7 and B-8, look up the total number of packages necessary for determining the tare; record n_t in box 12.

7. If n_t is larger than the initial tare sample, select additional tare sample packages, as necessary, from remaining packages arranged in the order in which the random numbers were obtained. It may be necessary to empty all the packages in the sample.

8. Gross weigh, empty, and determine the tare[1] for additional packages selected in step 7. Record these weights on a worksheet. If a foam product, record the test allowance in box 13a on the report form.

9. Follow steps 10-18 of Section 3.7. (page 3-16) to determine lot conformance.

3.11.6. Test Allowance for Foam Product Aerosols

Table 3-2 on page B-17 lists the test allowances to be subtracted from the average tare weight or individual package tare weight for foam product aerosols only. Record the test allowance in box 13a of the report form on page A-1. If all the sample packages have been exhausted for tare, note this on the report form and refer to a worksheet. When packages in the sample are exhausted for tare determination, the test allowance is subtracted from each individual tare before determination of the net weight of each package.

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[1] Apply test allowance given in Section 3.11.6. if foam product aerosol is being tested.

3.12. FROZEN FOOD AND OTHER FROZEN PRODUCTS

Complications arise in tare determination and, in some instances, in net weight determination of products that must be maintained at low temperature in order to keep them frozen. This is because of difficulties in separating, while still frozen, the contents from the package, and also because of the presence of superfluous ice and frost. The gross weight and tare weight of many products can be determined in a frozen state by simply brushing frost and ice from the exterior of the package. This suffices for most frozen prepared vegetables, fruits, and many convenience items. Although surface defrosting of poultry has been practiced in order to remove the bird from its wrapping, and thus measure part of the tare,[1] this method should be used with great care since surface discoloration occurs upon refreezing. Therefore, such packages chosen for tare determination should be used or disposed of as other than fresh or frozen food. (From the viewpoint of health, the surface defrosting method is acceptable.) However, a U.S. Department of Agriculture seal must be removed if an opened package is repackaged.

Frost found inside frozen food packages is considered part of the net contents, not tare.

In general, procedures to be followed for frozen foods labeled by weight are those given in Sections 3.5. (standard pack, dry tare), 3.6. (wet tare), 3.7. (alternative tare), or 3.8. (random pack).

A regulatory agency may define the labeled weight of a particular frozen product as the weight of that solid or semisolid material determined after defrosting; in such case, the procedures in Section 3.13. are followed.

3.13. DRAINED WEIGHT OF FROZEN FOODS

The following technique is based upon, but not identical with, Method 22.005 of the Official Methods of Analysis of the Association of Official Analytical Chemists.

It is a "drained weight" procedure and, as such, does not derive a package error from the package gross weight minus the nominal gross weight. The actual weight of defrosted product is measured. The method therefore requires the defrosting of all packages comprising the sample. Since loss of quality, texture, and moisture will result should the product be refrozen, the packages in the sample are not to be refrozen after the test.

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[1] Tare also includes inner wrappings, leg tags, pop-up thermometers, etc.

3.13.1. Equipment

Scales and weights recommended in Section 3.1.

Sieves

- For labeled weight of 3 lb (1.36 kg) or less, one 8-in (or 20-cm) No. 8 mesh U.S. Standard Sieve Series stainless steel sieve and receiving pan.

- For labeled weight greater than 3 lb (1.36 kg), one 12-in (or 30-cm) sieve, same specifications as above.

Stopwatch - mechanical or electronic, with a maximum error of 2 seconds in a 2-hour period.

4-gallon or larger container with bottom inlet for a hose attachment and either a screen-covered outlet on the upper part of the wall of the container or a wire mesh basket, which extends above the container.

Partial immersion thermometer with -30 to 120 °F (or -35 to +50 °C) range, 2 °F (or 1 °C) graduations, tolerance of ±2 °F (or ±1 °C).

3.13.2. Procedure

1. Fill out report form and select a random sample. A tare sample is not needed.

2. Weigh the sieve and receiving pan, recording weight on a worksheet as the "sieve weight".

3. If the sample packages are not water tight, the packages should each be placed in a plastic bag. Force excess air out of the bag by submerging it in water to a point above the location at which the bag is being tied off.

   Submerge the bags completely in a container of water using clamps or weights to keep the bags submerged. Maintain the water at 68 ± 4 °F (or 20 ± 2 °C) by introducing water at this temperature at the bottom of the container at a flow rate of 1 to 3 gallons per minute. Avoid agitating the packages.

4. As soon as the product thaws, as determined by loss of rigidity, remove each bag from the bath and open it with a minimum of agitation. With screen tilted at about 20° from the horizontal and supported for drainage, distribute the package contents over the screen in one sweeping motion. Let the product drain into a waste receptacle or sink.

5. Two minutes from the time the product was placed on the sieve, place the product and sieve on receiving pan and weigh. Record this weight on the worksheet as the "sieve + product weight".

6. The weight determined in step 5 minus the "sieve weight" (step 2) is the drained weight of the product. The package error equals the drained weight minus the labeled weight. Record the package error on the worksheet and on the report form.

7. Clean and dry the sieve and receiving pan and repeat steps 4 through 6 for the remaining packages in the sample.

8. Follow steps 7-11 of Section 3.5. (CORE METHOD) for the determination of lot conformance or nonconformance.

3.14. GLAZED RAW SEAFOOD AND FISH

The National Marine Fisheries Service of the U.S. Department of Commerce recommends that Method 18.001 (a) of the Official Methods of Analysis of the Association of Official Analytical Chemists be used for glazed raw seafood and fish. This method requires removal of the glaze before the product is weighed.

The method may be used for any frozen glazed food product.

3.14.1. Equipment

For equipment requirements, see Section 3.13.1. except:

- 8-in (or 20-cm) sieve is used for labeled weights of 2 lb (0.9 kg) or less.
- 12-in (or 30-cm) sieve is used for labeled weights greater than 2 lb (0.9 kg).

3.14.2. Procedure

1. Fill out a report form and select the random sample. A tare sample is not needed.

2. Weigh sieve and receiving pan. Record this weight on a worksheet as "sieve weight".

3. Remove each package from low temperature storage, open it immediately, and place the contents under a gentle spray of cold water. Agitate the product carefully so product is not broken. Continue the spray until all ice glaze that can be seen or felt is removed. The product should remain rigid.

4. Transfer the product to the weighed sieve. Without shifting product, incline the sieve to an angle of 17-20° to facilitate drainage and drain for exactly 2 minutes (into waste receptacle or sink).

5. Place the product and sieve on the receiving pan and weigh. Record this weight on a worksheet as the "sieve + product weight".

6. The net weight of product is equal to the weight of pan plus sieve plus product (recorded in step 5) minus the "sieve weight" (recorded in step 2). The product net weight should be recorded on the worksheet. The package error is equal to the net weight of the product as measured minus the labeled weight. The package error should be recorded on the worksheet and transferred to the report form.

7. Repeat steps 3 through 6 for each package in the sample, cleaning and drying the sieve and receiving pan between package measurements.

8. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

3.15. CANNED COFFEE

The variation in weight of the metal can used to package ground coffee can be substantial in comparison with the weight variation of the coffee itself; therefore, the alternative tare procedure of Section 2.11.4. may be necessary.

The gross weight of vacuum packed coffee before breaking the vacuum seal will be less than the gross weight after the seal is broken and air enters the can. This difference in weight will be measurable using the recommended small capacity scale for 2- and 3-pound canned coffee. (The gross weight difference for 1 lb coffee is about 1/2 g.)

The checking procedure follows Section 3.7. (standard pack, alternative tare). In step 3 of Section 3.7., the official can correct the gross weight determined from unopened cans in the following way:

Using the initial tare sample packages, the official should weigh and record the gross weight of the product-filled cans before and after breaking the vacuum seal. Compute the average gross weight difference (open weight minus sealed weight) and record this in box 13a. The nominal gross weight is equal to: the average tare weight minus the average difference in gross weights plus the labeled weight = box 13 - box 13a + box 1.

For example:

(i) A sample of 10 packages of 3-lb cans of coffee is selected; two packages are selected as the initial tare sample. The gross weight of the first unopened 3-lb can of coffee is 3.719 lb.

(ii) The gross weight of this same 3-lb can of coffee when opened is 3.723 lb.

The difference between (i) and (ii) is 0.004 lb.

This difference and the determination of the gross weight difference for the second tare sample package are averaged; 0.004 lb is found as the average value.

Therefore, 0.004 lb is, in this example, recorded in box 13a.

Section 3.7., step 4 onward, is then followed.

CHAPTER 4. METHODS OF TEST FOR PACKAGES LABELED BY VOLUME

4.1. Measuring liquid volumes

4.2. Equipment for liquid volume determinations

4.3. Using liquid volumetric measures

4.4. Standard pack liquids labeled by liquid volume: General method, part 1, measuring the weight of a known volume

4.5. Standard pack liquids labeled by liquid volume: General method, part 2, using the weight of the labeled volume

4.6. Other methods of liquid volume measurement

4.7. Milk

4.8. Mayonnaise and salad dressing

4.9. Paint, varnish, and lacquers - nonaerosol

4.10. Very viscous materials

4.11. Peat moss

4.12. Bark mulch

4.13. Solids or semisolids

4.14. Goods labeled by capacity

CHAPTER 4. METHODS OF TEST FOR PACKAGES LABELED BY VOLUME

This chapter first presents information on general problems and practices in measuring liquid volumes. Section 4.4. describes tests to check the suitability of weighing the net contents of packages labeled by volume. Section 4.5. describes a weighing method that references techniques already covered in Section 3.5. (CORE METHOD). Section 4.6. describes methods for use when weighing cannot be employed to check packages labeled by volume. Finally, methods for specific types of commodities are described in the remainder of the chapter. Packages labeled by dry volume or cubic measure are included in this category.

The procedures in this chapter return to the CORE METHOD of Section 3.5. for determination of lot conformance.

Determining the inspection lot, selecting the random sample and tare sample, and filling out the standard pack report form (page A-1) are not described in any detail in this chapter. The testing official is referred to Chapter 2, Appendix E, and Sections 3.5. through 3.7. for a more complete description of these procedures.

It should be noted that some packages labeled by volume utilize containers that are required by law or regulation to hold specified quantities (liquid or dry volume). These quantitative measuring containers include berry baskets and boxes, rigid dry measures, retail and prepackaged measure containers (such as ice cream containers), milk bottles, and lubricating oil bottles, and are covered by specific code requirements in NBS Handbook 44. Handbook 133 does not describe the testing of the capacities of these containers. Containers for such products as cottage cheese, sour cream, and yogurt may be tested by using the techniques of Section 4.14.

4.1. MEASURING LIQUID VOLUMES

The volume that is occupied by any kind of packaged product varies with the temperature of the product. This must be kept in mind when checking products labeled by liquid volume but can be ignored when checking products labeled by dry volume. For example, the volume of a liquid cosmetic product is 500 mL at 20 °C (68 °F) and 503 mL at 25 °C (77 °F). Therefore, a reference temperature is usually specified in regulations for products sold by liquid volume. The labeled volume is required to comply with the regulation at the reference temperature.

In general, the reference temperature is the temperature at which the product is customarily sold. For frozen foods labeled by liquid volume (e.g., fruit juices, batters, etc.), packagers routinely recommend a maximum storage temperature of 0 °F (-17.8 °C).[1] For foods that must be refrigerated to maintain quality, the reference temperature is 40 °F (4.4 °C).[2] The reference temperature for all petroleum products is 60 °F (15 °C).[3] For products sold unrefrigerated, the reference temperature is generally accepted as 68 °F (20 °C).[4] The reference temperature for beer is 39.1 °F.[5] The reference temperature for distilled spirits and wine is 60 °F.[6]

The following discussion applies to packaged products that are liquids at their reference temperature.

Whenever the liquid volume of a product is measured, the product temperature must be controlled and measured.

Since many liquid products have a high water content, the following information on water will guide the testing official as to the approximate errors that can arise from variations in temperature, and the effect of temperature on volume or on the weight of a known volume. For example,

1 gallon of water at 40 °F (4.4 °C) occupies:

> 1 gal + 0.28 fl dr at 50 °F (10 °C),
>
> (this corresponds to about 1/4 to 1/3 of a graduation on the neck of a one-gallon glass volumetric container);
>
> 1 gal + 0.9 fl dr at 60 °F (15.6 °C);
> 1 gal + 1.25 fl dr at 70 °F (21.1 °C).

---

[1] Frozen products labeled by liquid volume should be checked at the packaging plant. Those products with a high water content have a minimum volume at about 40 °F (4 °C) and a larger volume at 0 °F (-18 °C) than their volume at 40 °F (4 °C).

[2] 21CFR§101.105(b) (ii).

[3] 16CFR§500.8(b).

[4] 16CFR§500.8(b); 21CFR§101.105(b)(iii); 40CFR§162.10(2); 21CFR§201.62(b); 21CFR§701.13(b).

[5] 27CFR§7.10

[6] 27CFR§5.11 and 27CFR§4.10.

In the same way, 1 gallon of water would weigh[1] about

8.336 lb at 40 °F (4.4 °C),
8.334 lb at 50 °F (10 °C),
8.328 lb at 60 °F (15.6 °C), and
8.320 lb at 70 °F (21.1 °C).

These variations, although small, are detectable with the equipment recommended in this handbook. It is important to maintain only the packaged goods that will be opened for volumetric measurements at the same temperature. As will be described in Section 4.4., the testing official will deliver a known volume of product from one package and weigh it. Having repeated this procedure on a second package, the official will compare the weights of the two volumes in order to determine whether the rest of the packages in the sample can be weighed without opening those packages. Since the weight of a fixed volume of liquid will vary with the temperature, the official must determine the weights of the two volumes at the same temperature.[2]

Using the example of water, 1 gallon of water at 68 °F weighs 8.322 lb, but weighs 8.320 lb at 70 °F. As described in Section 4.4., if a difference of more than 0.004 lb is found between the weights of a known volume from two packages (using the equal arm scale for larger weights), weighing cannot be used to check the package net contents. For the example of water, the 2 °F difference in product temperature is enough to account for a 0.002 lb difference in the weight of one gallon.

In order to make package volume measurements on a refrigerated product without the product rapidly warming, it is good practice to equilibrate the volumetric glassware to the same temperature as the liquid product. For example, the official may put the flask to be used for checking milk in the cooler with the milk for about a half hour before checking the packages.

If volumes are determined on products at temperatures higher than their reference temperature of 60 or 68 °F, the measured volumes will be greater than at the reference temperature. By testing such products at or above the reference temperature, the official will always give the benefit of temperature errors to the packager.

Measurements of product volumes at lower than the reference temperatures of 60 or 68 °F normally will require the application of a density correction. Volumes of refrigerated food products determined at temperatures higher or lower than the 40 °F reference temperature will be larger than the volume determined at 40 °F because the maximum density of water (a principal component of most foods) occurs at 40 °F.[3]

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[1] Weighed in air.

[2] Alternatively, an agency may develop (or obtain from the packager) tables or formulae of volume/temperature variations which can be used to correct individual measurements to volume at the same temperature.

4.2. EQUIPMENT FOR LIQUID VOLUME DETERMINATIONS

Scales and weights recommended in Section 3.1. are suitable for the determination of the weight of a known volume.

Volumetric Measures - Measures specifically designed for package checking purposes may be used in making fluid volumetric determinations. (See Figure 4-1.) Standard measuring flasks and graduates recommended for use with packages labeled in inch-pound units are the gill, half pint, pint, quart, half gallon, and gallon. In addition, a 2-fluid-ounce cylindrical graduate, graduated to 1/2 fluid-dram is recommended. When checking packages labeled in metric units, flask sizes of 100 milliliters, 200 milliliters,[4] 500 milliliters, 1000 milliliters, 2000 milliliters, and 5000 milliliters and a 50-milliliter cylindrical graduate, graduated to 1 milliliter should be used.

Tolerances for inch-pound and metric field standard flasks and cylinders are given in Appendix I.[5]

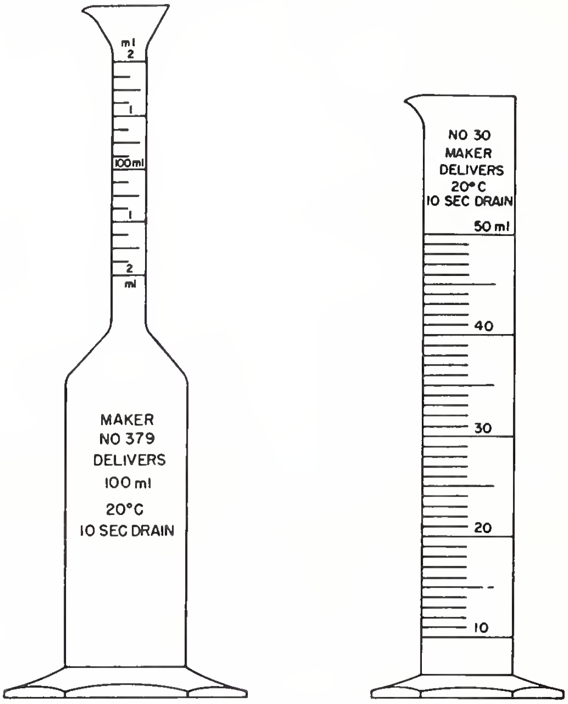

Figure 4-1. Standard measuring flask and graduate for testing packages labeled in metric units of volume.

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[3] This is also true for malt beverages (e.g. beer).

[4] 250-milliliter flasks may also be used.

[5] Flask manufacturers can supply standard measuring flasks with extended graduations on their necks (rather than those listed in Appendix I, Table I-2). These graduations can extend to the MAV for packages labeled by volume (e.g., for the half pint, graduations down to 3 drams below the half-pint mark may be specified for purchase).

A separate set of volumetric measures should be clearly marked and reserved for any testing of pesticides, herbicides, or similar products. Detergent washing of each set of volumetric measures between tests will then be adequate for field care and use. Volumetric measures suspected of contamination can be cleaned with a solution of potassium dichromate and sulfuric acid in a laboratory, not in the field.

Partial immersion thermometer with a range of -30 to 120 °F (or -35 to +50 °C), at least 1 °F (or 1 °C) graduations, and with a tolerance of ±2 °F (or ±1 °C).

Defoaming agents may be necessary for checking liquid commodities that effervesce or are carbonated, such as beer and soft drinks. Three such products are:

- Hexanol
- Octanol, (Capryl Alcohol), purified
- Antifoam B[1]
  Dow-Corning Corporation
  Midland, Michigan

The use of these defoaming agents renders the liquid commodities unfit for human consumption.

Bubble level.

4.3. USING LIQUID VOLUMETRIC MEASURES

Volumetric flasks are used in two ways for testing liquid products.

(i) Gravimetric measurement. An amount of product (not the entire package contents) is poured into a flask exactly to a specified mark on the neck of the flask and weighed. For example, the weight of the contents of a package labeled as 32 fluid ounces may be determined by weighing the contents of a pint flask filled with liquid product, then multiplying the result by two.

(ii) Volumetric measurement. The entire package contents are poured into one or more flasks. The liquid volume is determined by comparing the liquid level with the graduations on the neck.

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[1] The use of trade or brand names does not imply that they are endorsed or recommended by the Department of Commerce over similar products commercially available from other manufacturers.

Selecting the Flask

For fluid volume measurements, the choice of the volumetric flask to be used in any determination will depend on the labeled volume of the package. Even though packages may be labeled with a volume identical to the testing official's flask capacity, the amount contained in or delivered from any individual package may be less than the minimum mark inscribed on the inspector's flask. The lot codes on packaged liquids do not always correspond to single homogeneous batches of the liquid when being filled. Therefore, it is important to never mix liquids from two different packages (except for milk - see Section 4.7.). For this reasons, the official should use the flask sized closest to, but smaller than, the labeled volume for the determination of the weight of a known volume.[1]

Preparing the Flask

Because flasks are ordinarily calibrated on a "to deliver" basis, they must be "wet down" before using. Immediately prior to use, the volumetric flask(s) or graduate should be filled with water[2] to a point slightly below the top graduation on the neck. The flask should be emptied in 30 seconds (±5 seconds), tilting the flask gradually so that the flask walls are splashed as little as possible. When the main flow has ceased, the flask should be nearly inverted. Hold the flask in this position 10 seconds more and touch off the drop of water that adheres to the tip. The flask or graduate is then ready to accept product liquid from a package. This is called the "wet-down" condition.

Reading the Liquid Level

When reading or setting the liquid level in a flask or graduate, the official's eye should be at the same level as the liquid surface.

Due to surface tension, the liquid surface is curved near the junction of glass and liquid. Therefore, when reading or setting the liquid level, the center of the liquid level is to be compared with the graduation marks. For clear liquids, the bottom of the liquid surface (which will appear to have some thickness) is matched to or compared with a graduation mark; for opaque liquids, the center of the top rim of the liquid surface is the point to be set or to which comparison is made. (See Figure 4-2.) Of course, the flasks should be read on a level surface. (A bubble level may be used to ascertain the level condition.)

---

[1] The minimum mark on the graduated neck of standard flasks currently in use for package checking does not extend to the MAV limits described in Table 2-9. Therefore, it may be necessary for the official to use smaller flasks in combination with a cylinder to determine a package volume directly, that is, by delivering the contents into volumetric containers (method ii of this section).

[2] The water should be at the temperature of the product.

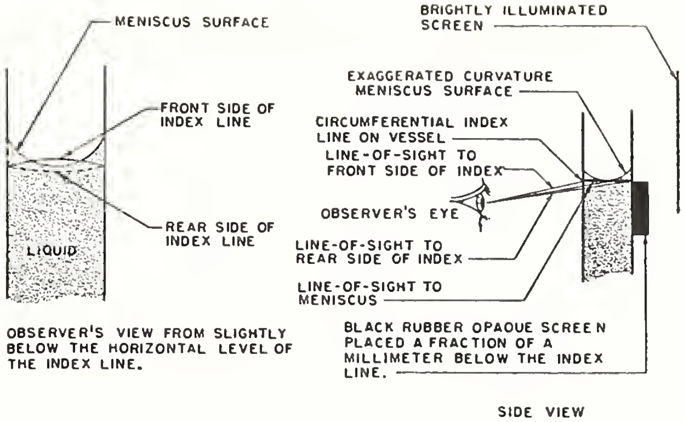
MENISCUS SURFACE
FRONT SIDE OF INDEX LINE
REAR SIDE OF INDEX LINE
LIQUID
OBSERVER'S VIEW FROM SLIGHTLY BELOW THE HORIZONTAL LEVEL OF THE INDEX LINE.
BRIGHTLY ILLUMINATED SCREEN
EXAGGERATED CURVATURE MENISCUS SURFACE
CIRCUMFERENTIAL INDEX LINE ON VESSEL
LINE-OF-SIGHT TO FRONT SIDE OF INDEX
OBSERVER'S EYE
LINE-OF-SIGHT TO REAR SIDE OF INDEX
LINE-OF-SIGHT TO MENISCUS
BLACK RUBBER OPAQUE SCREEN PLACED A FRACTION OF A MILLIMETER BELOW THE INDEX LINE.
SIDE VIEW

Figure 4-2. Reading the liquid level on the neck of a flask.

Using the Flask and Thermometer

Normal expansion or contraction of the glassware is relatively small and may be ignored. However, the testing official must never expose the glassware to a direct source of heat, such as a flame.

The flask should be washed (with detergent if necessary) and rinsed with water between deliveries of liquid product from different packages. The flask must be wet with water and drained as described for a "wet-down" each time it is to be used.

Immerse the thermometer (see equipment section) only 76 mm (or 3 in) into the liquid product. Measure the product temperature immediately after weighing the flask and product.

4.4. STANDARD PACK LIQUIDS LABELED BY LIQUID VOLUME: GENERAL METHOD, PART 1, MEASURING THE WEIGHT OF A KNOWN VOLUME

In order to avoid opening all of the packages comprising the sample and because measurements of volume are generally less precise than measurements of weight, the preferred method (described in this section and in 4.5.) is to determine the weight of the labeled volume. The weight of the labeled volume plus the tare weight is the nominal gross weight, to be used when comparing the gross weight of each unopened package.

The procedure is divided into two sections. This section describes a check for the variability of the weight of a known volume to decide whether a weighing procedure is suitable. If a weighing procedure can be used, consult the next section (4.5.) for a description of the use of a weight value for a known volume of product to determine package errors.

Section 2.10. gave the criteria for weighing packages not labeled by weight. Most common consumer products labeled by liquid volume (food, cosmetics, cleaning fluids, and over-the-counter drugs) weigh from about 0.05 lb per fl oz (0.8 g per mL) to about 0.07 lb per fl oz (1.1 g per mL). This permits the testing official to refer to a list of appropriate weighing devices to use to check these products and to skip the test that determines whether the scale can detect weights equivalent to MAV/6.

The measurement of the weight of a known volume can be combined with the determination of tare and, therefore, will not require more packages to be opened than the number designated in column 3 of Tables 2-2, page B-3, or 2-5, page B-5.

If the inspection lot is composed of packages from different lots, they will have different lot symbols or codes on the package: it is extremely important to check the weight of a known volume from each lot. The official may find that inspection lots of packages labeled by liquid volume must be sorted according to the manufacturer's lot code before sampling in order to check such packages by weighing.

Since many products labeled by liquid volume are packaged in glass containers, the official should become familiar with the alternative tare procedures of Section 2.11.4. as applied to liquids.

The general report form on page A-1 is designed for packages labeled by volume, length, count, etc. In addition, a two-page worksheet has been designed to lead the official through the entire procedure. The worksheets on pages A-5 and A-6 are referenced in the method below.

To minimize round-off errors, carry along at least two extra decimal places in any calculation until the final weight of the labeled volume is obtained.

The general method for checking packages labeled by liquid volume starts with measuring the weight of a known volume of the product.

1. Fill out the report form heading (page A-1) and select the random sample and random tare sample according to the lot size and sampling plan. (See Table 2-5, page B-5 for Category B plans and Table 2-2, page B-3 for Category A plans.) Record the labeled volume in box 1 as fluid ounces (if labeled in inch-pound units).

Refer to Table 4-1, page B-18, for the appropriate weighing device[1] and Table 4-2, page B-19, for maximum units of measure. Record the unit of measure in box 2 on the report form.

2. Gross weigh individual packages in the tare sample. Record these weights on the worksheet (page A-5) in item 1. Select a flask one size smaller than the labeled volume and weigh the flask in the "wet down" condition described in Section 4.3. Record in item 4 on the worksheet.

   If the liquid product requires mixing for uniformity, this should be done before opening each package. If the product is of a type that effervesces or foams when opened or poured (such as beer or carbonated beverages), add two drops of a defoaming agent to the bottom of the wetted flask before pouring.

   Open the first package selected for tare and fill the flask to the volume indication line.

---

[1] If the weight of a given volume of liquid product is less than 0.05 lb per fl oz (0.8 g per mL) or if recommended weighing equipment is not available, the following procedure should be followed in order to determine whether the scale is sensitive enough to detect individual package errors.

Calculate the weight of the volume that corresponds to MAV/6.

See worksheet for packages labeled by count (pages A-9 and A-10) for details in performing this calculation.

The weight of MAV/6 must be at least as large as 1/2 the size of the smallest division on any mechanical scale used to weigh the product (or at least as large as the smallest increment in the readout if a digital scale is being used).

If the weight difference is less than 1/2 the smallest scale division, all the packages will have to be opened and volumetric method A employed. (See Section 4.6.)

For example, packages labeled "1 quart" have an MAV of 8 fl dr (1 fl oz). The weight of the liquid is determined to be 0.770 lb for 16 fl oz., thus MAV/6 in weight units is:

$$\frac{1 \text{ fl oz}}{6} \times \frac{0.770 \text{ lb}}{16 \text{ fl oz}} = 0.008 \text{ lb}$$

In this example, assuming that the official has used a small-capacity equal-arm mechanical scale, MAV/6 is larger than the smallest scale division, so that the next step in the gravimetric procedure may be followed.

3. Weigh the flask filled with product (recording this weight in item 3 on the worksheet). (See Figure 4-3.) Then subtract the weight of the flask to obtain the weight of the product (item 5). Record the flask volume and product temperature for the first package in items 6 and 7 on the worksheet.

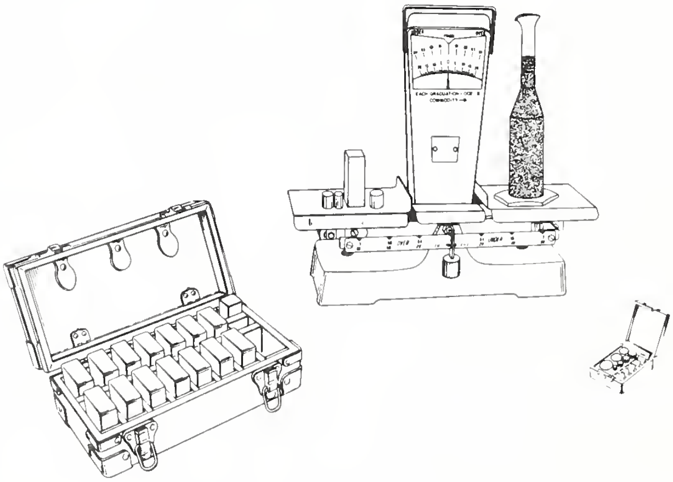

Figure 4-3. Weighing a known volume of liquid.

4. Empty, clean, and dry the package container. Weigh the package container and record this weight in item 2 of the worksheet.

5. Clean the flask and repeat steps 2, 3, and 4 on the second package chosen for tare determination. Only two packages are used to determine the weight of the known volume. (Even if more than 2 packages are required to determine tare, do not weigh their liquid contents.) Record the weight of the liquid volume from the second package, the flask volume, and the product temperature in items 5, 6, and 7 on the worksheet.

6. Determine tare for the rest of the tare sample. (There are spaces provided on the worksheet for five packages.)

7. When using any given scale to weigh packages labeled by volume, the two values for the weight of a known volume should not differ by more than the amount given in Table 4-3 (page B-20).

If the weights of the two packages meet the above criterion, then the average of the weights of the labeled volume may be used in testing the packages comprising the sample and Section 4.5. may be followed. Fill in item 8 of the worksheet. Go on to step 8.

If the weights differ by more than the value given in Table 4-3, page B-20, then volumetric measurements must be made on all the packages in the sample following one of the procedures given in Section 4.6.

Example: Two packages are chosen from a sample of ten packages labeled "1/2 gallon" for determination of the tare and of the weight of a known volume. The weight of a 1-quart flask plus 32 fl oz of the packaged liquid from the first package is 3.050 lb. The weight of 32 fl oz of the liquid is 2.048 lb. If using a small capacity package testing scale, the weight of 32 fl oz of the liquid from the second package may not differ from 2.048 lb by more than 0.002 lb (that is, it may weigh from 2.046 to 2.050 lb) if a weighing procedure is to be employed.

4.5. STANDARD PACK LIQUIDS LABELED BY LIQUID VOLUME: GENERAL METHOD, PART 2, USING THE WEIGHT OF THE LABELED VOLUME

After confirming that packages labeled by volume can be checked by weighing (as described in the previous section), the official should complete the checking procedure on the sample as described below. The following steps are intended to lead into Section 3.5., the CORE METHOD for packages labeled by weight.

8. Compute the average weight of the labeled volume of the product.

The average weight of the labeled volume =

$$\frac{\text{average weight of known volume}}{\text{known volume}} \times \text{labeled volume}$$

The average weight of the labeled volume may be obtained by first determining the average of the two values in item 5 on the worksheet. Record in item 9 on the worksheet. Then follow the instructions in item 10 on the worksheet.

9. In steps 4 and 6 of Section 4.4. the tare weights of the individual packages in the tare sample were determined. If additional tare sample packages are indicated (using the method of Section 2.11.4.), select, gross weigh, open, clean, and weigh the containers. Average the tare weights determined from all opened containers (unless the entire sample has been opened). Record average tare weight in item 12 on the worksheet and box 13 on the report form.

10. The average tare plus the weight of the labeled volume of the product is the "nominal gross weight". Record nominal gross weight in step 13 of the worksheet and in box 14 of the report form.

    Items 14 and 15 of the worksheet provide space for recording package errors for the first five packages opened for tare.

11. Look up the MAV for the labeled volume in Table 2-9, pages B-11 and B-12 and record it in box 3 on the report form and item 16 on the worksheet. Convert the MAV in units of volume to units of weight:

    MAV (weight) =

$$\text{MAV (volume)} \quad \times \quad \frac{\text{average weight of labeled volume}}{\text{labeled volume}}$$

    To convert, multiply the value recorded in item 16 on the worksheet by the value recorded in item 10 and divide by the labeled volume recorded in box 1 on the report form. Record this value in item 17 on the worksheet.

    Convert the MAV to dimensionless units as described in item 18 on the worksheet and transfer this value to box 4 on the report form. With all measurements converted to weight and dimensionless units, determine package errors and lot conformance for unopened packages by following the CORE METHOD in Section 3.5., step 6 onward.

    Convert the average error back to units of volume following the arithmetic in item 19 on the worksheet when completing the report form.

4.6. OTHER METHODS OF LIQUID VOLUME MEASUREMENT

If the packaged product fails either criterion in Section 4.4. (step 1 footnote or step 7), the official should use one of the methods of liquid volume measurement described in this section.

All three of these methods of determining an individual package error require opening all sample packages. After the errors have been determined for all packages, the CORE METHOD in Section 3.5. (step 7 onward) is followed to determine conformance of the lot with the package requirements.

Method A is used if the scale cannot detect differences in weight equivalent to MAV/6 and may be used as an alternative to any other fluid measurement given here.

Method B is suitable for liquids that are homogeneous.

Method C is suitable for liquids that are not homogeneous, but may also be used for homogeneous liquids.

4.6.1. Method A: Determining the Volume at the Liquid Level of Fill. (Depth Gage Method)

When the test in step 1, footnote, Section 4.4., indicates that the scale is not sensitive enough to detect individual package errors, the following method must be used. It is a laboratory procedure. In order to determine the volume of liquid in each package in the sample, the level of fill of each package is duplicated with water (from pipets and a buret).

Equipment

Micrometer depth gage (ends of rods fully rounded)[1] 0-9 in or 0-225 mm.

Bubble level at least 10 in or 25 cm in length.

Laboratory pipets and/or buret:
Buret meeting type 1, style 1, class A, Fed Spec NNN-B-782.
Pipets meeting type 1, style 1, class A, Fed Spec NNN-P-395, calibrated "to deliver."

Procedure

1. If following this section after Section 4.4., select one or more packages to replace the package(s) opened in Section 4.4. If this is the method of choice, select a random sample. Fill out the report form heading (page A-1).

2. Open the first package in the sample on a level surface. Use the depth gage to determine the level of fill of the package before product is removed.

   Record the depth gage reading on a worksheet.

3. Empty, clean, and dry the package container.

---

[1] The rods will have to be custom ground.

4. Duplicate the level of fill determined in step 2 above with distilled water delivered from pipets or buret. Record the resulting water volume as the packaged goods volume on the worksheet.

5. Subtract the labeled volume from the actual package volume (recorded in step 4) to arrive at the individual package error. Record the package error on the worksheet and convert it to dimensionless units in order to transfer to the report form.

6. Repeat steps 2 through 5 for each package in the sample. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.6.2. Method B: Measuring the Weight of a Known Volume for Every Package

The following method is suitable for liquids that are homogeneous (or can be mixed until they are homogeneous) and do not separate quickly. Taking advantage of product homogeneity, this method uses the weight of a known volume to calculate the weight of the labeled volume. Since weighing is used to determine errors in volume, the scale must be capable of distinguishing volumes equivalent to MAV/6 (See Section 4.4., step 1, footnote.)

Equipment is the same as that listed in Section 4.2.

Summary

Section 4.4. describes the determination of the weight of a known volume of product from two packages. When the range of weights from two packages exceeds the Table 4-3 value, the method of Sections 4.4. and 4.5. may still be used as long as the weight of a known volume is determined for each and every package in the sample.

The net weight of each container is measured. The weight per unit volume of each container is measured, as well. The net weight of each container is multiplied by its weight per unit volume to calculate the contained volume.

Procedure

The numbered steps follow step 7 in Section 4.4.

8. Compute the weight of the labeled volume for the first package opened from the tare sample.

   The weight of the labeled volume for package 1 =

   $$\frac{\text{weight of known volume (from package 1) x labeled volume}}{\text{known volume}}$$

Record this weight on a worksheet. Repeat this calculation to obtain the weight of the labeled volume for the second package from the tare sample. Record this weight on the worksheet. Do not average the weights of the labeled volumes for the two packages.

9. Subtract the sum of the actual tare weight plus the weight of the labeled volume computed in step 8 (above) from the package gross weight to arrive at the individual package errors (in terms of weight) for the first two packages opened for tare in Section 4.4.

   Package error (in units of weight) =

   (gross weight) - (tare weight + weight of labeled volume)

   The package error in units of weight should be recorded on a worksheet.

   Calculate the package error in units of volume:

   Package error (in units of volume) =

   $$(\text{package error in units of weight}) \times \frac{\text{labeled volume}}{\text{weight of labeled volume}}$$

   For example, the tare weight of package 1 is 0.075 lb and the weight of the labeled volume (32 fl oz) for package 1 is 2.156 lb. The gross weight of package 1 is 2.245 lb. The package error in units of weight is therefore: (2.245 lb) - (0.075 lb + 2.156 lb) = +0.014 lb. In units of volume, the package error is (+0.014 lb) x (32 fl oz)/(2.156 lb) = +0.21 fl oz.

10. Gross weigh the remaining packages in the sample. (Only the tare sample packages were weighed in Section 4.4.)

11. Determine the weight of a known volume for each package in the sample. (See steps 2 and 3 of Section 4.4.)

12. Clean, dry, and weigh each package container (to determine each tare weight).

13. Repeat steps 8 and 9 above for each package in the sample.

14. Transfer package errors to the standard pack report form on page A-1 (using an appropriate unit of measure in terms of volume).

    Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.6.3. Method C: Measuring the Volume Delivered from the Package

The product does not have to be homogeneous to use this method, but the product should be mixed before opening even if its components separate quickly. Oil and vinegar salad dressings are good examples of the type of product for which this method can be used. Unlike Method B, this method uses the weight of a known volume only to calculate the volume remaining in an emptied container so that any inhomogeneity of the product will not greatly affect the calculated net contents.

In steps 3 and 5 of Section 4.4., the weight of a known volume of liquid is determined for each of two packages in the sample. When it is found in step 7 that these weights differ too much from each other, the following method may be followed to determine package errors.

It is possible to use an average weight of a known volume to determine the amount of liquid remaining in a package after delivery of the main body of liquid to volumetric flask(s) as long as the two weights determined in steps 3 and 5 of Section 4.4. do not differ by more than 5%. (See calculation in step 8 on page 4-17.) For example, if the weights of 8 fl oz of product were determined to be 0.496 lb for the first package and 0.484 lb for the second package, the difference, 0.012 lb, is less than 5% of the average weight, 0.490 lb. Therefore, 0.490 lb for 8 fl oz may be used to calculate the liquid volume remaining in the packages.

If the weights determined in steps 3 and 5 of Section 4.4. differ by more than 5%, a method such as 4.6.2., (Method B) must be used. This method will require both the determination of the weight of a known volume and a direct measurement of product volume delivered from the package for every package. (In this instance, the results of steps 3 and 5 of Section 4.4. may be used only for the weights of a known volume for the first two packages opened for tare. The weight of a known volume will have to be determined for each package in the sample.)

The equipment is the same as that listed in Section 4.2.

Summary

The contents are emptied into a flask and measured volumetrically. The volume of product remaining in the emptied container is obtained by determining the weight difference between the wet container and the container after drying. This weight is converted to volume:

$$\frac{\text{(wet container - dried container weight) x known volume}}{\text{weight of known volume}}$$

This resultant volume is then added to the volume of product delivered from the package to obtain the total product volume.

Procedure

The numbered steps below follow step 7 in Section 4.4.

8. Calculate the average weight of the labeled volume as described in step 8 of Section 4.5. Divide the difference in weights for the first two package volumes by the average weight of the labeled volume. If this ratio is 0.05 or smaller, use the average weight of the labeled volume to compute the amount of liquid remaining in the package in step 13. If the ratio is greater than 0.05, separate values for the weight of a given volume must be determined for each package in the sample to be used in step 13.

9. Returning to the first package opened in step 2, Section 4.4., deliver the rest of the package contents into graduated flask(s) and/or a graduate and record the total delivered volume on a worksheet.

   The volume of product still left in the package must now be determined.

10. Weigh the empty (but wet) package container.

11. Clean, dry, and weigh the package container.

12. Record the difference in weight between wet and dried tare on the worksheet.

13. Calculate the volume of liquid left in the package. If the ratio calculated in step 8 above is 0.05 or smaller, the remaining volume of liquid in the package is calculated to be:

$$\frac{\text{weight difference (step 12) x labeled volume}}{\text{average weight of labeled volume (step 8)}}$$

If the ratio is greater than 0.05 in step 8, the remaining volume of liquid is:

$$\frac{\text{weight difference (step 12) x labeled volume}}{\text{weight of labeled volume for each package}}$$

(Or Method B, Section 4.6.2., may be followed.)

Record remaining volume in the package on the worksheet.

14. Add the volume remaining in the package as determined in step 13 to the volume poured from the package (determined in step 9 and recorded on the worksheet) to arrive at the total volume.

Total product volume =

volume delivered into flasks or graduates +

volume remaining in package

15. Subtract the labeled volume from the total package volume determined in step 14 to arrive at the individual package error.

Package error (units of volume) =

(total product volume) - (labeled volume)

Record package error on the worksheet and in the crosshatched area of the worksheet (identifying an appropriate unit of measure in box 2).

16. Repeat steps 9 through 15 above for the second package opened. If the ratio calculated in step 8 is 0.05 or smaller, the average weight of the labeled volume may be used (already calculated in step 8).

If the ratio calculated in step 8 is greater than 0.05, the weight of a known volume of product from this package would already have been determined in Step 5 of Section 4.4. This weight of a known volume can be used in step 13 above for this package only.

17. If the ratio calculated in step 8 is 0.05 or smaller, open each package in the sample, deliver its contents into flask(s) and a graduate as described in step 9 above, and repeat steps 10 through 15 using the average weight of the labeled volume already determined in step 8. Repeat for every package in the sample.

    If the ratio calculated in step 8 above is greater than 0.05, determine the weight of a known volume as described in Section 4.4. for each of the remaining packages in the sample following each determination with steps 9 through 15 above.

    After package errors for sample have been determined, follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

Example

From a sample labeled "40 fl oz" the first package was opened and part of the product was poured into a 1-qt flask to the 1-qt mark.

The remaining product was then poured into a 1/2-pt flask and was found to fill the flask to 1/2 fl dr below the 8-fl oz mark.

Therefore, the volume delivered from the package is
= 32 fl oz + 8 fl oz - 1/16 fl oz
= 39.9375 fl oz delivered.

The weight of the wet package container is 1.012 lb and after air drying, 1.000 lb. According to procedures followed in steps 3 and 5 of Section 4.4., it was found for the two tare sample packages that 32 fl oz weighs 2.123 lb (average weight).

Thus,

$$\frac{(1.012 \text{ lb} - 1.000 \text{ lb}) \times 32 \text{ fl oz}}{2.123 \text{ lb}} = 0.18 \text{ fl oz}$$

This is the volume of product remaining in the package.

The total product volume is therefore:
39.94 fl oz + 0.18 fl oz = 40.12 fl oz

The package error is
40.12 fl oz - 40.00 fl oz = +0.12 fl oz

4.7. MILK

Because of the homogeneity of milk within a production lot, some steps in Section 4.4. are eliminated if the inspector is careful to define the inspection lot as that product from a single production lot code.

Equipment is the same as described in Section 4.2. except that the selected flask may be equal in volume to that declared on the milk container.

Summary

Sections 4.4. and 4.5. are followed except:

- In step 2 of Section 4.4., if product delivered from the first container does not fill the flask to a graduation line, milk from a second package may be added to bring the liquid level up to the graduation.
- Steps 5, 6, and 7 of Section 4.4. may be skipped. As a result, only one package is used to determine the weight of the labeled volume of the product in step 8 of Section 4.5.

Procedure

The method is as follows. Deviations from Sections 4.4. and 4.5. are underlined.

1. Fill out report form heading (page A-1) and define the inspection lot as packages with a single lot code. Record the labeled net contents (box 1), unit of measure (box 2), the lot size (box 5), sample size (box 6), tare sample size (box 7), and allowed number of unreasonable errors (box 8). (For Category A, see page B-3; Category B, page B-5.) Select the random sample and random tare sample.

2. Keep temperature of tare sample and flasks as close as possible to 40 °F. Gross weigh tare sample packages and record on worksheet in item 1 (page A-5).

   Select flask of same size as labeled volume. Wet down flask. Weigh flask and record weight on worksheet (item 4).

   Open first tare sample package and fill flask to the flask volume indication line. Open second package and add milk if there is insufficient milk in the first package to fill to the line.

3. Weigh flask and milk and record weight in item 3 of worksheet. Subtract flask weight to determine the weight of the milk; record in item 5 of the worksheet. Take temperature of milk in flask. Record flask volume and temperature in items 6 and 7 on worksheet.

4. Empty tare sample packages, clean and dry the containers. Weigh containers and record in item 2 of worksheet.

5. Skip item 8 on the worksheet. Items 9 and 10 (assuming that the flask volume equals package labeled volume) are the same value as recorded in item 5. Compute the average tare weight for the tare sample (individual weights recorded in item 2) and record in item 12 on the worksheet and in box 13 on the report form.

6. Compute the nominal gross weight by adding the average tare weight (item 12) to the weight of the labeled volume (item 5). Record in item 13 on the worksheet.

7. Compute the package errors for the tare sample packages.

   Package error =
   gross weight for each package - nominal gross weight

   On the worksheet: item 14 = item 1 - item 13

8. Convert package errors in weight units to dimensionless units.

   On the worksheet: item 15 = item 14 ÷ unit of measure (box 2 of report form)

   Record package errors for tare sample on report form.

9. Find the MAV in Table 2-9, page B-11 or B-12 and record it in box 3 on the report form. Convert MAV from units of volume to units of weight as described on the worksheet in item 17.

10. Convert the MAV to dimensionless units as described on the worksheet in item 18.

11. Compare unopened sample packages with the nominal gross weight as described in the CORE METHOD, Section 3.5., step 6 onward, and determine lot conformance.

12. Convert average package error back to units of volume as described in item 19 on the worksheet.

    Record this value in box 19 of the report form.

4.8. MAYONNAISE AND SALAD DRESSING

The following method is also suitable for other water-immiscible products without a level liquid surface. This method is provided for mayonnaise and salad dressing because the volume of such products is changed by scooping or stirring the product.

The method determines the amount of air space above the product in the package, and then the total container volume. Subtracting the airspace volume from the total container volume gives the product volume.

4.8.1. Equipment

Volumetric measures recommended in Section 4.2.

Plastic disks (to be used with the procedure of fill described in Section 4.14.)

4.8.2. Procedure

1. Fill out the report form heading and select a random sample. A random tare sample is not needed.

2. Open the first package and place a disk larger than the package container opening over the opening. Deliver water from a graduate through the central hole in the disk onto the top of the product until the container is filled (as described in step 3 of Section 4.14.2. on the use of the plastic disks). Record the volume of water as "headspace" on a worksheet.

3. Empty, clean, and dry the package container.

4. With the disk over the opening, fill the package container with water from flask(s) and graduate(s). Record the amount of water as "container volume" on the worksheet.

5. Subtract the volume recorded in step 2 from the volume recorded in step 4. This is the volume of product in this individual package.

6. Subtract the labeled volume from the package volume determined in step 5 to arrive at the individual package error in units of volume. Record package error in the crosshatched area of the report form using an appropriate unit of measure in box 2.

7. Repeat steps 2 through 6 for the remaining packages in the sample.

   Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.9. PAINT, VARNISH, AND LACQUERS - NONAEROSOL

This section describes three different test methods that may be employed depending upon the required degree of accuracy and the location of the check. The procedures are: a field auditing method, usually conducted on the premises of the vendor; an in-plant auditing method; and a "possible violation" method which is designed for laboratory or in-plant use because of clean-up and product collection requirements.

Although the procedures are suitable for use with products labeled by volume and packaged in cylindrical containers with separate lids which can be resealed, the various steps have been set forth using paint as the example. A worksheet for audit or possible violation (page A-7) is also included.

4.9.1. Equipment

Scales and weights recommended in Section 3.1.

Volumetric measures recommended in Section 4.2.

Micrometer depth gage (ends of rods fully rounded)[1], 0 to 9 in (0 to 225 mm).

Diameter tape measure, 2 to 12 in or 5 to 30 cm.

Spanning bar, 1 by 1 by 12 in or 2.5 by 2.5 by 30 cm.

Paint solvent or other solvent suitable for the product being tested.

Rule, 12 in or 30 cm.

Cloth, 12 in or 25 cm square.

Wood, 12 in or 25 cm long, 2- by 6-in.

Rubber mallet.

Circular metal disc, 1/4 in or 0.65 cm thick and slightly smaller than the diameter of package container bottom.

Rubber spatula.

Bubble level.

Optional: Micrometer.

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[1] The rods will need to be custom ground.

4.9.2. Field Auditing Procedure

The following procedure is suitable only for use in checking products put up in cylindrical containers up to 1 gal or 4 L in capacity. Step 2a can be used with any sized containers and 2b with 1-gallon or 4-L containers only. The method determines by calculation the volume of a single can in the sample, selected as most likely to contain the smallest volume of product. It does not require emptying any containers, only measuring critical dimensions of the container.

The configuration of the bottom of the can, paint clinging to the lid, and slight variations in the wall and label thicknesses of the paint container may produce an uncertainty estimated to be at least ±0.6 percent in this auditing procedure. This method is therefore recommended solely to eliminate from more rigorous testing those packaged products that appear to be full measure. Section 4.9.4. is recommended when the volume determined in step 9 of this section is less than the labeled volume or in any case where short measure is suspected.

1. Fill out the report form heading and select a random sample. A tare sample is not needed.

2. a. Any container up to 1 gal or 4 L:

   Measure the outside diameter of each container near its middle (as shown in Figure 4-4) to the closest 0.001 in (or 0.02 mm), using a direct reading diameter tape measure. Record readings in column 3 of the Worksheet for Checking Paint (page A-7) in the audit section.

   Set the containers on a level surface and record their heights on the worksheet under column 1 in the audit section. If the range of outside diameters exceeds 0.005 in (or 0.125 mm) or the range in heights exceeds 0.0625 in (or 1.58 mm), this procedure cannot be used. If the ranges are within the specified limits, open all cans in the sample and select the container with the greatest headspace as determined by visual inspection or with the use of the micrometer depth gage. Replace all lids except that of the selected container and reseal the lids by placing a cloth and then a section of wood on lid and hammering on the wood with a rubber mallet. Tip the cans upside down momentarily to complete the resealing operation. Continue with step 3 below.

2. b. 1-gal or 4-L cans:

This test is appropriate when the weight of the paint is much greater than the weight of the can and is, therefore, applicable for 1-gal or 4-L sizes only.

Gross weigh each package in the sample. Select the package from the sample with the lightest gross weight. Carefully remove the lid of this can.

3. Measure the outside diameter of the selected container near its top, middle (already measured if step 2a was used), and bottom, to the closest 0.001 in (or 0.02 mm), using a direct reading diameter tape measure. Record these measurements in columns 2, 3, and 4 on the paint worksheet in the audit section.

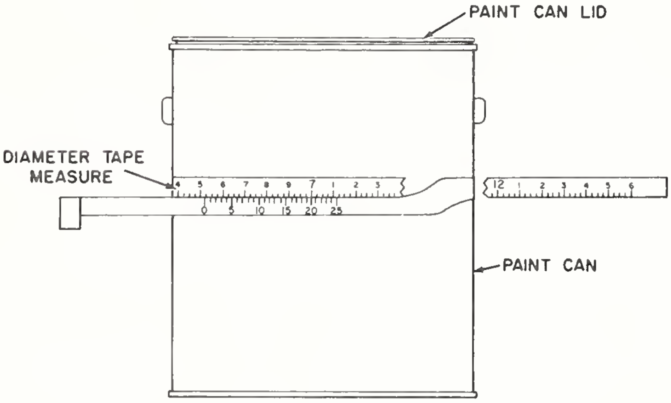

Figure 4-4. Measuring the diameter of a paint can.

Sum the three diameter values and divide by three to obtain the average diameter. Record the average diameter in column 5 of the paint worksheet.

4. If a micrometer is available, measure the wall and the paper label thickness of the container; otherwise, assume the wall and label thicknesses given in Table 4-4, page B-21.

Subtract twice the wall and paper label (if any) thickness from the average can diameter (step 3) to obtain the average liquid diameter. Record the liquid diameter in column 6 of the paint worksheet.

5. On a level working surface, place the container of paint on the circular metal disc slightly smaller in diameter than the bottom rim of the can so the bottom of the container nests on the disc as shown in Figure 4-5. This eliminates the "sag" in the base of the paint container.

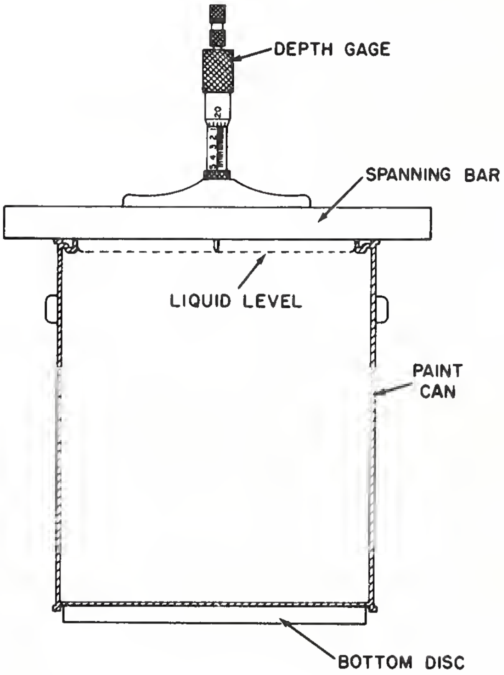

Figure 4-5. Measuring the distance to the liquid level.

6. Place the spanning bar and depth gage across the top of the paint can as shown in Figure 4-5. Mark the location of spanning bar on rim of paint container. Measure the distance to the liquid level to the nearest 0.001 in (or 0.02 mm) at three points in a straight line, at points approximately 3/8 in from the inner rim for cans 5 in in diameter or less (1/2 in from the rim for can diameters exceeding 5 in), and at the center of the can as shown in Figure 4-6. If working in metric units, measure at 1 cm from the rim for cans with diameters of 15 cm or less and 1.5 cm from the rim for can diameters exceeding 15 cm. Sum the three readings and divide by three to obtain the average distance to the liquid level in the container. Record the average distance to the liquid level in column 7 of the audit section on the paint worksheet.

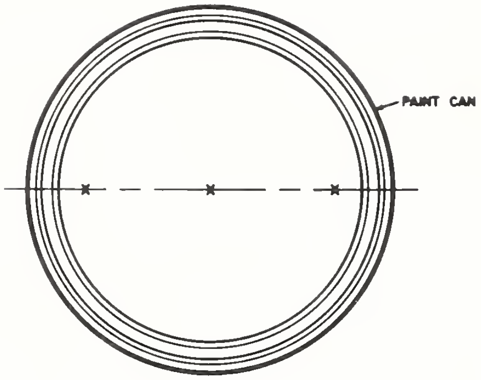

Figure 4-6. Top view of paint can showing locations at which depth measurements are made.

7. Measure the distance to the bottom of the container (Figure 4-7) at three points in a straight line in the same manner as outlined in step 6. Sum the three readings and divide by three to obtain the average height of the container and record it in column 8 of the paint worksheet in the audit section.

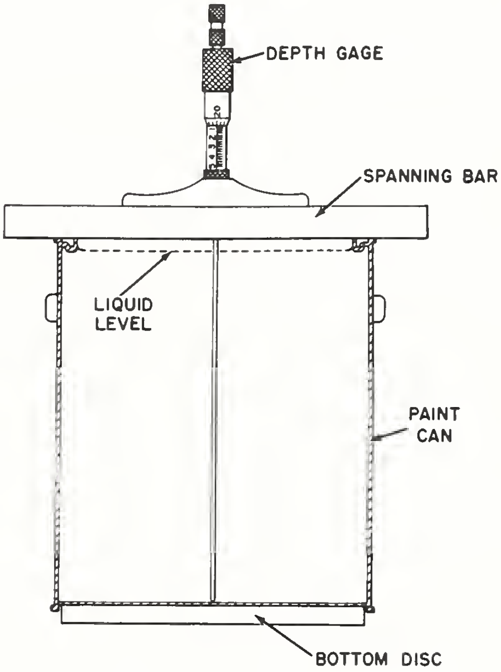
DEPTH GAGE
SPANNING BAR
LIQUID LEVEL
PAINT CAN
BOTTOM DISC

Figure 4-7. Measuring the distance to the bottom of a container.

8. Subtract the average distance to the liquid level (column 7) from the average height of the container (column 8) to obtain the average height of the liquid column and record it in column 9 of the paint worksheet.

9. Determine the volume of paint in the container by using the following formula:

$$\text{Volume} = 0.7854\ D^2H$$

$$= 0.7854 \times D \times D \times H$$

Where D = average liquid diameter (column 6) and
H = average liquid height (column 9)

Record this volume in column 10 of the paint worksheet.

If this calculated volume is less than the labeled volume, go on to Section 4.9.4.

4.9.3. In-Plant Auditing Procedure

This method is applied to a container that is likely to contain the smallest volume of product. The level of fill is duplicated with water in a can of the same dimensions as the one under test. The method can be used to check any size of package provided that the liquid level is within 9 inches of the top of the container.

Follow steps 1 through 5 of Section 4.9.2. If any paint is found clinging to the side walls or lid, carefully scrape the paint into the container with a rubber spatula.

6. Place the spanning bar and depth gage across the top of the paint can. Measure the distance to the liquid level at the center of the surface and record the level in the audit section of the paint worksheet in column 7. (See page A-6.)

7. Select an empty can with the same bottom configuration as, and with diameter and height within ±0.001 in (or ±0.025 mm) for 1-pt (or 500 mL) cans, ±0.002 in (or ±0.05 mm) for 1-qt (or 1-L) cans, ±0.003 in (or ±0.075 mm) for 1/2-gal (or 2-L) cans, and ±0.004 in (or ±0.1 mm) for 1-gal (or 4-L) cans, of the container under test. Set the empty can on a level work surface with a circular metal disc slightly smaller in diameter than the bottom can rim underneath the can to eliminate sag. (See Figure 4-5.) Set up spanning bar and depth gage as in step 6 above. Fill the container with water from a volumetric measure of the

same volume as the labeled volume. Measure the distance to the liquid level at the center of the container and record this level in column 7 below the reading recorded in step 6. If this distance is equal to or greater than the distance determined in step 6, assume that the package is satisfactory. If the distance is less than the distance determined in step 6, short measure may be suspected. Use the possible violation procedure given in the next section when short measure is suspected.

4.9.4. Possible Violation Procedure

The following method may be used provided that the liquid level is within 9 inches of the top of the container. The steps noted with an (a) are required if paint is found adhering to the lid and cannot be removed by scraping into the can.

It may be necessary to use the alternative tare procedure of Section 2.11.4., although the following steps do not specifically include that technique.

1. Fill out the standard pack report form (page A-1), select the random sample and random tare sample.

2. Do not shake or invert the containers selected as the sample. Determine the gross weight of these packages and record in the lower section of the paint worksheet headed "Possible Violation" (page A-7). Also record the labeled volume in column 1 of this worksheet. Select first tare sample package. Use circular metal disc to eliminate can sag as shown in Figure 4-5 and described in step 5, Section 4.9.2. Remove the lid. If paint is clinging to the side walls, scrape it down into the can with the spatula.

2a. If paint adhering to the lid cannot be removed completely by scraping the paint into the can, determine the weight of the lid plus any adhering paint. Clean the lid of paint with solvent and weigh again. Subtract the clean lid weight from the lid weight with paint to determine the weight of the paint adhering to the lid. Record this weight in column 3 of the paint worksheet.

3. Place the spanning bar and depth gage across the top of the paint can. Mark the location of the spanning bar on the rim of the paint container. Measure the distance to the liquid level at the center of the container to the nearest 0.001 in (0.02 mm). Record the distance in column 4 of the paint worksheet.

4. Empty and clean the sample container and lid with a suitable solvent; dry and weigh the container and lid. Record the tare weight in column 5.

5. Set up the container in the same manner as in step 2 above.

6. Place the spanning bar at the same location on the rim of the paint container as marked in step 3. With the depth gage set as described in step 3, deliver water into the container in known amounts[1] until the water reaches the same level occupied by the paint as indicated by the depth gage. Record this volume of water (in fl oz or mL) in column 6 of the paint worksheet. This is the volume occupied by the paint in the container. Follow steps 7a, 8a, and 9a if paint could not be removed from lid by scraping. Follow steps 7, 8, and 9 otherwise.

7. Subtract the weight of the container (column 5) from the gross weight (column 2) to arrive at the net weight of paint in the selected container. Record the net weight in column 7 on the paint worksheet.

7a. Subtract the weight of the container (column 5) and the weight of product on the lid (column 3) from the gross weight (column 2) to arrive at the net weight of paint in the container. Record in column 7.

8. Calculate the weight of the labeled volume of paint =

$$\frac{\text{net weight (col. 7) x labeled volume (col. 1)}}{\text{volume of paint in can (column 6)}}$$

Record this value in column 8 of the worksheet.

8a. Calculate the package volume =

$$\text{volume in can (col. 6)} +$$

$$\text{lid paint weight (col. 3)} \quad \text{x} \quad \frac{\text{can volume (col.6)}}{\text{net weight (col.7)}}$$

Record it in column 9 of the worksheet.

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[1] One method of measuring water delivered into the container is to use a volumetric measure of the same size as the labeled quantity of paint. Fill the measure to the mark with water and pour the water into the package container. Add or subtract the water necessary to reach the same level occupied by the paint with the aid of a syringe dropper and small graduate. The volume occupied by the paint is the volume of the test measure plus the additional water added or minus the water removed from the package container.

9. Calculate package error.

Package error = (column 6 value) - (labeled volume)

9a. Package error = (column 9 value) - (labeled volume)

10. Repeat steps 2 through 9a (above) for the second package chosen for tare.

In order to use weighing to check the sample, the weights of the labeled volume for the first two packages (recorded in column 8) should not differ from each other by more than the value given in Table 4-3 (page B-20). If this criterion is met, the rest of the sample may be checked by weighing. The nominal gross weight is equal to the sum of the average weight of the labeled volume plus the average tare. Go to step 6 of the CORE METHOD described in Section 3.5. to complete the test.

It should be noted that the weight of a given volume of paint often varies considerably from container to container; therefore, volumetric measurements may prove necessary for the entire sample. In such instances, the criterion of Table 4-3 will not be met. Follow steps 2 through 9a but skip steps 7, 8, and 9, if paint is adhering to the lid (or steps 2 through 6 if paint is not adhering to the lid) for all the packages in the sample. When package errors have been determined in this manner, go to Steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.10. VERY VISCOUS MATERIALS[1]

The following method can be used for any package labeled by volume, but is especially suitable for very viscous materials such as cartridge-packed caulking compounds, glues, pastes, and the like, often packed in tubes. This is most suitable as a laboratory procedure using a hood to ventilate solvent fumes, if necessary. If used in the field, a well-ventilated area should be chosen to conduct the test if solvents other than soap and water must be used.

Except for the special measurement procedures to determine the weight of the labeled volume, this procedure follows Sections 4.4. and 4.5. for standard pack liquids labeled by volume. For each weight of a known volume determination, a portion of the packaged product is packed into a preweighed cup of known volume (called a density cup or pycnometer) and weighed. From the weight of the known volume, the weight of the labeled volume can be determined. This weight (plus the tare) can then be compared with the actual net weight to determine the package error.

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[1] Based on a method devised by Mr. James Little, NBS.

4.10.1. Equipment

Small-capacity scale and weights recommended in Section 3.1.

Pycnometer, a vessel of known volume for weighing semifluids. The pycnometer can be purchased or constructed. If constructed, it will be referred to as a "density cup".

To make a 150-mL or 5-fl oz density cup, cut off the lip of a 150-mL beaker with an abrasive saw and grind the lip flat on a lap wheel. (See Figure 4-8.) The slicker plate can be purchased commercially.

Appropriate solvents (water, Stoddard solvent, kerosene, alcohol, etc.).

Caulking gun (for cartridge-packed products).

4.10.2. Preparation for Test

Weigh and calibrate pycnometer or the complete density cup unit (cup and slicker plate) with respect to volume (mL or fl oz) prior to use. Calibrate the density cup gravimetrically with respect to the contained volume using the procedure given in NBS IR 74-461, "The Calibration of Small Volumetric Glassware". Special instructions furnished by the manufacturer may be necessary in order to calibrate a pycnometer not already calibrated. It is not necessary to reweigh or recalibrate for each test; however, the pieces of each unit should be marked to prevent interchange of cups and slicker plates.

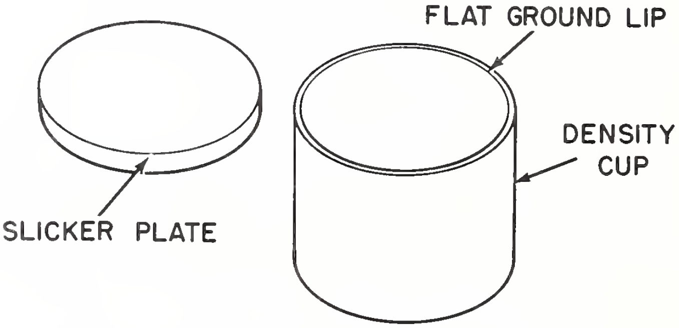

Figure 4-8. Empty density cup and slicker plate.

4.10.3. Procedure

1. Determine inspection lot, fill out the report form heading (page A-1) and select the random sample and tare sample.

2. Weigh a calibrated pycnometer or density cup and slicker plate and record on the worksheet on pages A-5 and A-6 as "pycnometer weight" or "cup and plate weight" in place of "flask weight" in item 4. Also record the pycnometer or cup volume (item 6 on this worksheet).

3. Gross weigh and then open the first package in the tare sample. Record the package gross weight on the worksheet in item 1. Transfer the product to the pycnometer or density cup, filling the pycnometer or cup to excess. Use a caulking gun for transferring product from caulking cartridges. Remove the product as completely as possible from the package container, clean package container with solvent, dry and weigh it. (Record this weight as "tare weight" in item 2 on the worksheet.)

4. If pycnometer is used, cover with lid and screw cap down tightly. Excess material will be forced out through hole in lid. Clean exterior surfaces.

   If using density cup, place the slicker plate over 3/4 of the cup mouth (see Figure 4-9), press down, and slowly move the plate across the remainder of the opening. With the slicker plate kept in place, clean all exterior surfaces with solvent and dry them.

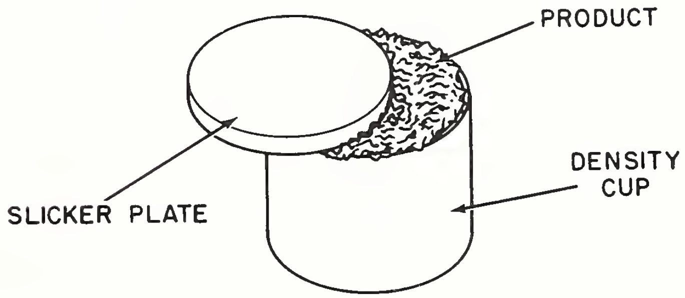

Figure 4-9. Density cup filled with product.

5. Weigh filled pycnometer or filled density cup with slicker plate to at least the nearest 0.002 pound or nearest gram. Record this weight in item 3 on the worksheet. Subtract the weight of the empty pycnometer or cup and plate (item 4 on worksheet) from the filled weight to arrive at the weight of the product contained in the pycnometer or density cup. Record this weight on the worksheet in item 5.

6. Clean the pycnometer or density cup and repeat steps 3, 4, and 5 for the second package in the tare sample.

   If the weights recorded in item 5 on the workshet differ from each other by more than the value in Table 4-3, page B-20, then all the packages will have to be opened to determine their package errors. Go to step 8 in this event.

7. Calculate the weight of product corresponding to the labeled volume of product =

   $$\frac{\text{product weight in cup x labeled volume}}{\text{density cup volume}}$$

   If using pycnometer, substitute product weight in pycnometer and pycnometer volume in above equation. (See items 9 and 10 on the worksheet.) Continue to follow the instructions on the worksheet to determine lot conformance.

8. If an average weight of the labeled volume cannot be used to determine the nominal gross weight, that is, if the "yes" box is checked in item 8 on the worksheet, the gross weight of each package minus its tare weight is the actual weight of product in each individual package being measured. Record this as the "net weight" on another worksheet. Subtract the weight of the labeled volume (determined for each package as given in Step 7) from the net weight of product to arrive at each individual package error in units of weight.

   Convert the package errors to units of volume.

   Package error (volume) =

   $$\frac{\text{Package error (weight) x cup volume}}{\text{weight of product in cup}}$$

   (If using pycnometer, substitute pycnometer volume for cup volume and weight of product in pycnometer for weight of product in cup in above equation.)

Record the package errors on the standard pack report form on page A-1 using an appropriate unit of measure.

Follow Steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.11. PEAT MOSS

Peat and peat moss are labeled by weight, by "compressed volume," and by volume. The following method is for use in testing the volume declaration, incuding the volume that can be recovered from the compressed state.[1] ASTM D 2978-71, "Standard Method of Test for Volume of Peat Materials", is the reference standard for the procedure.

Every package in the sample is opened.

This method is suitable for particulate solids (such as soils or other garden materials) labeled in cubic dimensions or dry volume. Some materials may not pass through the sieve specified below for peat moss; in these instances, separate the materials by hand (to compensate for packing and settling of the product after packaging) before filling the test measure (see step 2 below).

4.11.1. Equipment

12.5-mm (or 1/2-in) sieve.

Wooden or metal container, with inside dimensions of 12 by 12 by 12 in marked off in 1-in horizontal lines on the inside (1-cu ft container) or of 50 by 50 by 40 cm marked off in 5-cm horizontal lines (0.1-m^3 container). This container is not commercially available, but has to be constructed.

Straight edge, 20 in (50 cm) in length.

Sheet for catching overflow of material.

Bubble level.

4.11.2. Procedure

1. Determine inspection lot, fill out the report form heading, and select the random sample. No tare sample is needed.

2. Open each package in turn, removing the contents and passing them through the sieve directly into the measuring container (overfilling it). Shake the measuring container with a rotary motion at one rotation per second for 5 seconds. Do not lift the measuring

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[1] The compressed volume declaration can only be checked by measuring the package dimensions or by liquid displacement (see Section 4.13.).

container when rotating it. If package contents are greater than the measuring container capacity, level the measuring container with a straight edge using a zig-zag motion across the top of the container. Empty the container. Repeat the filling operations as many times as necessary, noting the partial fill of the container for the last quantity delivered using the interior horizontal markings as a guide. Record the amount of material on a worksheet.[1]

3. Compute each package error (= actual measurement minus the labeled measurement) and record it on the worksheet. Transfer the package errors to the report form using an appropriate unit of measure in box 2 of the report form. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.12. BARK MULCH

The National Conference on Weights and Measures recommended the following method for bark mulch.[2]

4.12.1. Equipment

Construct test measure of materials (for example, 1/2-inch plywood) that will not bulge when filled with mulch. Interior dimensions should be 9 inches by 16 inches by 48 inches high, with 2 opposite inside walls of the measure marked or scribed at 1/2-inch intervals. Other interior dimensions are acceptable as long as the container approximates the configuration of the package under test (e.g., 12- by 12-inch cross section). Container height may also be reduced from 48 inches, but this will restrict the maximum size of package that can be tested. A lexan or plexiglass side wall is useful for determining the level of fill, but may need to be reinforced.

Each half inch of depth of the test measure is equivalent to 72 cubic inches of volume in the 9- by 16-in or 12- by 12-in configurations.

4.12.2. Procedure

1. Determine inspection lot, fill out report form heading, and select the random sample. No tare sample is needed. A special MAV of 5% of the declared volume is applied for bark mulch.

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[1] Use conversion factors (such as "Factors for High Precision Conversion", NBS Letter Circular 1071, July 1976) to convert from cubic measure to dry volume, if necessary.

[2] Report of the 68th National Conference on Weights and Measures, 1983, NBS Special Publication 663.

2. Open each package in turn. Empty contents of bag into container and level the contents by hand. Do not rock, shake, drop, or tamp the container. Read the horizontal marks to determine package net volume.

   Record each package error. Package error =
   (package net volume) - (labeled volume)

3. After package errors for the entire sample have been recorded, follow steps 7-11 of the CORE METHOD in Section 3.5. to determine lot conformance.

4.13. SOLIDS OR SEMISOLIDS

The following procedure can only be used to test packaged products that are solid or semisolid and that will not dissolve in, mix with, absorb, or be absorbed by the fluid into which the product will be immersed. For example, frozen desserts labeled by liquid volume are tested using kerosene as the immersion fluid.

Every package must be opened. The product is removed from its package and completely submerged in water or other fluid in a container. The volume of the product may be determined either (a) by noting the difference in volume registered by comparison with graduated markings on the container or (b) by measuring the volume of water or fluid overflowing from a container previously filled to overflow capacity.

4.13.1. Equipment

Either of the following:

- o Graduate or volumetric flask of capacity larger than the labeled volume of package being tested.
- o Container with overflow spout of physical dimensions large enough to contain commodity, plus graduate or volumetric flask equivalent to labeled volume.

Thin wire.

Water or other fluid that will not dissolve or mix with package contents.

Bubble level.

4.13.2. Procedure

1. Determine inspection lot, fill out the standard pack report form heading, page A-1, and select the random sample. A tare sample is not needed.

2. On a level surface, follow either (a) or (b) below.

   a. Select a graduate of larger capacity than the labeled volume of the package. Partially fill it with water or other liquid to a volume which will still allow the packaged product to be added to the graduate without exceeding the graduated portion of the graduate. Record this volume on a worksheet.

      Open the first package and submerge the product by pushing the product into the liquid with the wire. Record the resulting volume as "fluid and product" on the worksheet.

      The volume of the product is the difference between liquid levels, "after" minus "before" adding the product to the graduate. Record it as "net volume of product" on the worksheet.

   b. Select container with overflow spout and fill it to overflowing with water or other liquid; allow to sit until dripping stops. Place a graduate or other volumetric container of a capacity large enough to contain the package volume at the spout. Open the first package and carefully submerge the product using the thin wire to push the entire product below the liquid level. The volume of liquid displaced by the product (including the final dripping of liquid into the container or graduate) is the volume of the product. Record this volume as the "net volume of product" on a worksheet.

3. The volume of the product (as determined by 2a or 2b above) minus the labeled volume is the individual package error. Record the package error on the worksheet and transfer to the report form using an appropriate unit of measure. Repeat steps 2 and 3 (as appropriate) with the remainder of the packages in the sample. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.14. GOODS LABELED BY CAPACITY

The capacity of packaged products such as bowls, pots, glasses, cups, etc. is labeled in terms of liquid volume and is defined as the brim-full or level-full capacity unless there are markings of capacity on a side wall of the product, or a ridge capable of accepting a lid. (In the former instance, the capacity is defined as the capacity at the designated mark. In the latter instance, the capacity is defined as the capacity at the level of the ridge or "seat".) The procedures presented below are for determining the brim-full, marked or seated capacity of a container.

4.14.1. Equipment

Volumetric Flasks and graduate as described in Section 4.2.

500-milliliter buret meeting Type 1, Style 1, Class A requirements of Fed Spec NNN-B-782.

Rubber bulb syringe.

Plastic Disks. 1/8-in or 3-mm thick disks with diameters to correspond to seat diameter or larger than brim diameter of each container tested. Diameter tolerance is ±0.002 in or ±0.05 mm. The outer edge should be beveled at a 30-degree angle with the horizontal to 1/32 in or 0.8 mm thick at the edge. There should be a 3/4-in or 20-mm diameter hole through the center of the disk and a series of 1/16-in or 1.5-mm diameter holes 1 in or 25 mm apart around the periphery of the disk and 1/8 in or 3 mm in from the outer edge. All edges should be smooth. (See Figure 4-10.)

Bubble level.

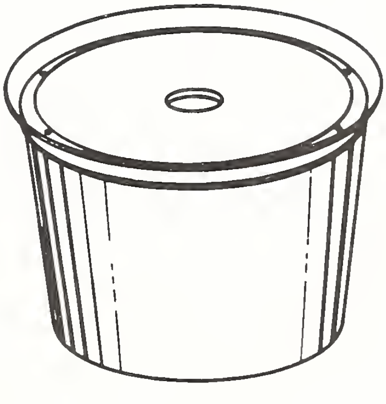

Figure 4-10. Plastic disk (beveled edge upward) inserted in the seat of a container to be tested.

4.14.2. Procedure[1]

The following procedures are divided into (a) determination of flush fill to brim or (b) determination of capacity to seat. The working surface must be level for all test procedures. After describing the procedure, information is presented on testing a container to a marked capacity not using the plastic disks.

1. Determine inspection lot, fill out the standard pack report form heading (page A-1), and select the random sample. A tare sample is not needed.

2. a. Select a plastic disk with a diameter larger than the outside brim diameter of the container to be tested. Place the disk with the beveled edge upward on the container. Center the disk on the container. (See Figure 4-11.)

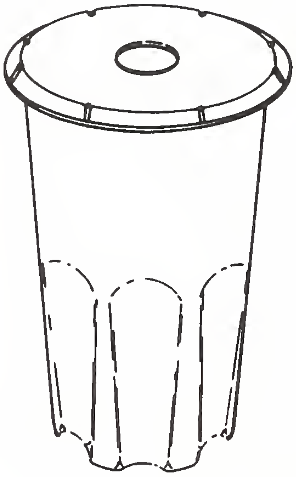

Figure 4-11. Disk in place for flush fill (or brim-full) capacity determination.

2. b. Select a disk with a diameter equal to the seat diameter of the container being tested. Insert the plastic disk on the seat of the container with the beveled edge upward. (See Figure 4-10.)

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[1] Plastic disk procedure provided by the American Can Co., Neenah, Wisconsin.

3. Add water to the container using flask (or flasks), graduate, or buret corresponding to labeled capacity of the container. If it appears that the contents of the flask may overfill the container, do not empty the flask. Add water until all of the air in the container has been displaced and the water begins to rise in the center hole of the disk. Stop the filling procedure when the water fills the center disk hole and domes up slightly due to the surface tension.

   If the water dome breaks on the surface of the disk, the container has been overfilled and the test is void; dry the container and start over.

   Do not add additional water after the level of the water dome has dropped.

4. Record on a worksheet the amount of water used to fill container and subtract 0.03 fl oz (1 mL) (corresponding to the amount of water in the disk hole) to obtain the container capacity. Record the container capacity as "net capacity" on the worksheet.

5. Compute the package error (= net capacity minus the labeled capacity), record it on the worksheet, and transfer it to the report form using an appropriate unit of measure.

   Repeat this procedure on the remaining packages in the sample. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

When testing containers with markings of capacity on the side wall of the container, water from a buret, flask, or graduate should be added to each container to obtain a level of fill corresponding to the markings. The official should record the amount of water used to reach the mark (similar to filling a volumetric flask to a mark if the container walls are transparent) as the container capacity. Then follow step 5 above to complete the test.

CHAPTER 5. METHODS OF TEST FOR PACKAGES LABELED BY COUNT, LENGTH, AREA, THICKNESS, OR COMBINATIONS OF QUANTITIES

5.1. Packages labeled by count when the labeled count is 51 or more units per package

5.2. Packages labeled by count when the labeled count is 50 or fewer units per package

5.3. Packages labeled by linear or square (area) measure

5.4. Polyethylene sheeting

5.5. Paper plates

5.6. Sanitary paper products

5.7. Pressed and blown glass tumblers and stemware

CHAPTER 5. METHODS OF TEST FOR PACKAGES LABELED BY COUNT, LENGTH, AREA, THICKNESS, OR COMBINATIONS OF QUANTITIES

Many commodities and manufactured products are sold in units of quantity other than weight or liquid or dry volume. For example, food wrap is sold by length, width, and area. Polyethylene sheeting is sold by length, width, area and thickness. Disposable paper plates are sold by the number in the package and by their diameter.

This chapter provides general procedures for packages labeled by count or length and procedures for specific commodities such as polyethylene sheeting.

When packaged goods are labeled by two or more units (for example, count and dimension, or capacity, etc.), each labeled quantity must meet the average requirements unless other requirements pertain.

The National Conference on Weights and Measures (NCWM) Uniform Method of Sale of Commodities Regulation (MoS)[1] has provided an exception to the average requirements: pressed and blown glass tumblers and stemware are given tolerances; the average requirement does not apply. A special sampling plan and test procedure are provided for pressed and blown tumblers and stemware (Section 5.7.).

For statistical reasons, an exception to the average requirement applies to packages labeled by low count (less than 51 units per package). This chapter provides a set of sampling plans to be used in such instances (Section 5.2.).

5.1. PACKAGES LABELED BY COUNT WHEN THE LABELED COUNT IS 51 OR MORE UNITS PER PACKAGE

Two methods are presented here for determining count without opening all packages in the sample. Both use the weight of a counted number of packaged units or items. One of these methods is intended as an audit procedure only. Of course, if the weight of discrete units or numbers of units is found to be too variable, the official must count packaged units rather than weigh them.

5.1.1. Equipment

Scales and weights recommended in Section 3.1.

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[1] The NCWM MoS appears in NBS Handbook 130 and is a standard for State regulatory use that is periodically revised by State agency representatives. Not all 50 States have regulations based on this model.

5.1.2. Audit Procedure

Since the precision of the method is only ±1 percent, determination of lot conformance and further action based on shortages of count must rely either on actual count or Section 5.1.3.. However, this method is useful for auditing packages labeled by high unit counts (in excess of 100).

1. Determine inspection lot, fill out the standard pack report form heading (page A-1), and select the random sample and random tare sample.

2. Gross weigh the first package in the tare sample. Record this weight on a worksheet.

3. Select the number of items, either (a) or (b), from the first tare package that weighs the greater:

   a. 10 percent of the labeled count,

   b. a quantity sufficient to indicate at least 50 minimum divisions on the package checking scale. For example, using the package checking scale with 1/16-oz divisions, the selected count must weigh at least 3 1/8 oz. For the package checking scale with 1-g divisions, the selected count must weigh at least 50 g. Record the count and weight on the worksheet.

4. Calculate the weight of the labeled count

   $$= \frac{\text{labeled count x weight (step 3)}}{\text{count (step 3)}}$$

   Record the result on the worksheet as "labeled count weight".

5. Gross weigh the rest of the tare sample and keep contents of opened packages separated in case Section 5.1.3. must be followed. Determine the tare weights of the tare sample and record these on the worksheet.

6. The weight of the labeled count plus the tare weight represents the "nominal gross weight".

   Package error (weight) =

   (actual package gross weight) - (nominal gross weight)

   Compare the unopened packages with the nominal gross weight and record the package errors on the worksheet.

7. Convert the package errors in units of weight to count:

   Package error (count)

   $$= \frac{\text{Package error (weight) x labeled count}}{\text{labeled count weight (step 4)}}$$

   Round any fractional counts computed in this manner to whole units in favor of the packager. Record the package error in units of count in the crosshatched area of the report form. Compute the average error. If the average error is minus, follow Section 5.1.3. to determine lot conformance. If the average error is equal to zero or positive, the lot is presumed to conform to the package requirements.

5.1.3. Possible-Violation Procedure

Special worksheets have been developed to accompany the report form. The worksheets on pages A-9 and A-10 guide the inspector through the procedure.

The measurement of the weight of the number of units in the package is combined with the determination of tare and, therefore, will not require opening more packages than the tare sample.

If the procedure in Section 5.1.2. has been used, procedure 5.1.3. can be followed with the same sample if package contents have been kept separate and can still be counted.

1. Determine inspection lot, fill out the report form heading (page A-1), and select the random sample and random tare sample. Record the labeled count in box 1 on the report form.

2. Gross weigh the packages selected for tare determination and record their gross weights in item 1 of the worksheet. Open these packages.

3. Determine and record the net package contents weight and the exact number of items in the first opened package.

   Record the weight in item 4 and the count in item 3 on the worksheet.

4. Record the MAV from Table 2-10 (page B-13) in units of count in box 3 on the report form and in item 6 on the worksheet.

   In order to determine whether the scale used to weigh the packages is able to discriminate differences in count, calculate the weight equivalent to MAV/6. MAV/6 must be at least as large as 1/2 the size of the smallest mechanical scale division (or at least as large as the smallest increment in the readout on a digital scale). (See items 7 and 8 on worksheet.)

   For example, from Table 2-10 the MAV is 7 units for a package labeled with a count of 250 units. The scale should be capable of discriminating differences corresponding to MAV/6 or, in this example, one unit.

   If the criterion above is not met, count the package contents in each package in the sample; if met, go on to step 5.

5. Determine and record on the worksheet in item 2 the tare weight of the first package opened.

6. Determine and record the weight and the count of the package contents in the second package opened for tare (items 3 and 4 on the worksheet).

7. Calculate the weights of the labeled counts for the first two packages.

   Weight of labeled count

   $$= \text{labeled count} \times \frac{\text{contents weight}}{\text{contents count}}$$

   Record these weights in item 5 of the worksheet.

   To avoid round-off errors, carry over at least two extra decimal places in the calculation until the weight of the labeled count is obtained.

   The difference in weights of the labeled counts of the two packages must not exceed the value given in Table 4-3 (page B-20). Fill in item 9 on worksheet.

   If the difference in weights does not meet this criterion, determine the actual count per package for every package in the sample. If the difference meets this criterion, average the weights of the labeled count and go on to step 8.

8. Determine the tare for the rest of the tare sample if any additional tare sample packages remain. Record the tare values on the worksheet. Average the tare weights (record in item 10 on the worksheet and box 13 on the report form).

9. The average weight of the labeled number of items in the package (step 7) plus the average tare weight (step 8) equals the "nominal gross weight". Record the nominal gross weight in item 11 on the worksheet and in box 14 on the report form.

   Package error (weight) =

   (actual package gross weight) - (nominal gross weight)

   Record package errors for the tare sample packages (items 12 and 13 on the worksheet).

10. Convert the MAV to units of weight:

    $$\text{MAV (weight)} = \text{MAV (count)} \times \frac{\text{average weight of labeled count}}{\text{labeled count}}$$

    See item 14 on worksheet for calculation.

    Convert the MAV to dimensionless units and record in item 15 on the worksheet and box 4 on the report form.

    With all measurements converted to weight and dimensionless units, go to Step 6-11 of .Section 3.5. (CORE METHOD) to determine lot conformance. Convert back to count when completing box 19 of the report form by following the calculation in item 16 on the worksheet.

5.2. PACKAGES LABELED BY COUNT WHEN THE LABELED COUNT IS 50 OR FEWER UNITS PER PACKAGE

A special sampling plan is provided for packages labeled by count when the number of units per package is 50 or fewer. The sampling procedure requires counting the number of units in each package in the sample and noting the number of those packages that contain less than the labeled count. The MAV is not used directly in the sampling plan. The required number of packages for the sample, tare sample, and the allowed number of undercount packages are given in Table 5-1 (page B-22). Average count does not apply.

Procedure

1. Determine inspection lot, fill out report form heading. Sample size and tare sample size are found in Table 5-1, page B-22. Record the column 4 value from Table 5-1 (the number of packages that are permitted to contain fewer than the labeled count) in box 8 of the report form.

   The MAV in units of count is found in Table 2-10 (page B-13) and recorded in box 3 on the report form.

2. Follow steps 2 through 9 of Section 5.1.3.

   If it is possible to determine count by weighing, compare the gross weight of the unopened packages in the sample with the nominal gross weight. Individual package errors are equal to the actual gross weights minus the nominal gross weight.

   If it is necessary to open every package in the sample and count the contents, the package error is equal to the actual count minus the labeled count. Record the package errors.

3. Circle and count the number of minus package errors of any size. If this number is larger than the number in box 8 of the report form, the lot fails to comply with the package requirements. If the number of minus package errors is less than or equal to the number recorded in box 8 of the report form, the lot complies.

The MAV's listed in Table 2-10 for packages labeled by count and fewer than 51 units per package define the limits of reasonable variation for an individual package even though the MAV is not used directly in the sampling plan. Individual packages that are undercount from the labeled count by more than the MAV are, however, considered defective (even if the lot as a whole passes inspection); they should be repacked, relabeled, or otherwise handled.

Example

An official must test a lot of 360 packages of cotton balls labeled "50 cotton balls". A random sample of 10 packages is chosen from the lot. Because his scale cannot discriminate differences in count, the inspector opens every package and counts the balls. The 10 package counts are: 50, 52, 50, 50, 51, 53, 52, 50, 47, 50.

Referring to Table 5-1, since only one package contains fewer than 50 balls, the inspector declares the lot to have passed the test.The package containing 47 balls should not be introduced into commerce even though the lot complies with the package requirements.

5.3. PACKAGES LABELED BY LINEAR OR SQUARE (AREA) MEASURE

The weight of the labeled linear or area measure may be used together with the tare weight as the nominal gross weight, as long as the scale used to weigh the packages can discriminate the weight equivalent to MAV/6 and the weight of the labeled measure does not vary outside the ranges permitted in Table 4-3 (page B-20). Worksheets similar to the one provided for count (pages A-9 and A-10) should be devised and used for length or area measurements.

Products labeled by length or area often require the application of tension to the ends of the product before measurement in order to straighten the product. Tension must be applied to woven or twisted fiber products such as thread, yarn, rope, cording, twine, etc. Because of the specialized equipment required for these products (and because such equipment is not readily available outside the packaging plant), the official is referred to the following standards suitable for in-plant inspection together with sampling plans described in this handbook. These standards are: "Standard Method of Test for Yarn Number by the Skein Method", ASTM D1907-75, for thread and yarn; "Standard Methods of Testing Twine Made from Bast and Leaf Fibers", ASTM D1233-73, and "Standard Tolerances for and Methods of Testing Single Jute Yarn", ASTM D541-71.

Textiles labeled by length should be inspected using textile measuring devices that have been found to conform with the tolerances of NBS Handbook 44.

5.3.1. Equipment

Scales and weights as recommended in Section 3.1.

T-square.

Steel tapes and rules:

Inch-pound:
For labeled dimensions 25 in or less, 36-in rule with 1/64-in or 1/100-in divisions, overall length tolerance of 1/64 in.

For labeled dimensions greater than 25 in, 100-ft tape with 1/16-in divisions, overall length tolerance of 0.1 in.

Metric:
For labeled dimensions 40 cm or less, 1-m rule with 1/2-mm divisions, overall length tolerance of 0.4 mm.

For labeled dimensions greater than 40 cm, 30-m tape[1] with 1 mm divisions, overall length tolerance of 2.5 mm.

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[1] The markings specified for the equivalent metric rule and tape may be incorporated in the inch-pound rule and tape.

5.3.2. Procedure

1. Determine inspection lot, fill out the standard pack report form on page A-1, and select the random sample and tare sample. Separate report forms and worksheets (replacing all "count" terms with "dimensions" on page A-9 and A-10) should be filled out for packages labeled by separate dimensions and/or area.

2. Gross weigh and open the packages selected for tare determination. Record on the worksheet in item 1.

3. Determine the measurements (to the nearest division of the appropriate tape or rule) of the packaged goods (length, width, area - depending upon which dimensions are declared on the label) and weigh the goods from the first package opened for tare determination.

   Record the weight and measure on the worksheet in items 4 and 3. Calculate the weight of the labeled measurement on the worksheet following item 5.

   Weight of the labeled measurement =

   $$\text{labeled measurement} \quad \times \quad \frac{\text{contents weight}}{\text{contents measurement}}$$

   Record the MAV in units of length or area measure (given in Table 2-11, page B-14) in box 3 of the report form and on the worksheet in item 6.

4. Calculate the length or area of packaged product corresponding to MAV/6. Convert the MAV/6 to units of weight (in item 7) of the worksheet. MAV/6 in units of weight must be at least as large as 1/2 of the smallest division on a mechanical scale used to weigh the product (or at least as large as the smallest increment in the readout, if a digital scale is being used). (See item 8 on the worksheet.)

   For example, an inspector finds that 200 sq ft of product weights 2.000 lb; 1 sq ft must therefore weigh 0.010 lb. For the small capacity scale, this is 5 times the usual minimum scale division (0.002 lb); therefore, the first criterion is met.

   If this criterion is met, go on to the next step. If not, all packages in the sample must be opened in order to measure the contents.

5. Determine and record in item 2 on the worksheet the tare weight of the first package opened.

6. Determine the measurements of the product in the second package chosen for tare determination (item 3). Determine the tare weight of this package and record on the worksheet (item 2). Calculate and record the weight of the labeled measurement for the second package (item 5).

7. The weights of the labeled measurement for two packages must not differ by more than the value given in Table 4-3 (page B-20). If they do, all packages in the sample must be opened, measured individually, and compared against the labeled measure to determine the package errors. (See item 9 on the worksheet.) If Table 4-3 criterion is met, go on to step 8.

8. Calculate the average weight of the labeled measurement and record it on the worksheet in item 9.

9. Determine the tare weights of the rest (if any) of the tare sample. Record on the worksheet and average the tare weights (item 10 on the worksheet).

10. The average weight of the labeled measurements (item 9 on the worksheet) plus the average tare weight (item 10 on the worksheet) equals the nominal gross weight. Record the nominal gross weight on the worksheet in item 11 and in box 14 on the report form.

    Package error (weight) =

    (actual package gross weight) - (nominal gross weight)

11. Determine the package errors for the tare sample following the arithmetic in items 12 and 13 on the worksheet and transfer these values to the crosshatched area of the report form.

12. Convert the MAV to units of weight.

MAV (weight)

$$= \frac{\text{avg. wt. of label measurements x MAV (length)}}{\text{labeled measurements}}$$

Record MAV in units of weight on the worksheet in item 14.

Convert the MAV to dimensionless units as shown in item 15 on the worksheet. With all measurements converted to weight, follow steps 6-11 of Section 3.5. to determine lot conformance. Convert package errors in weight to length (or area) when completing the report form using the formula in step 16 on the worksheet.

5.4. POLYETHYLENE SHEETING

Polyethylene sheeting is sold not only by its linear or area measurement and net weight, but also by its thickness. The procedure to check thickness is based on ASTM D374 "Standard Test Methods for Thickness of Solid Electrical Insulation".

First the net weight of the product and dimensions of the sheeting are checked. If the net weight and dimensions conform to the package requirements, the thickness of the sheeting is then checked. All the sample packages are opened for thickness measurements.

A worksheet is provided to record length, width and thickness measurements for polyethylene sheeting on page A-11.

5.4.1. Equipment

Scales and weights recommended in Section 3.1.

Micrometer:

- A deadweight dial micrometer (see Figure 5-1) equipped with a flat anvil, 1/4-in (or 6-mm) diameter or larger, and a 3/16-in (or 4.5-mm) diameter flat surface on the head of the spindle. The anvil and spindle head surfaces should be ground and lapped, parallel to within 0.0001 in (or 0.002 mm), and should move on an axis perpendicular to their surfaces. The dial spindle should be vertical and the dial should be at least 2 in (or 50 mm) in diameter. The dial indicator should be continuously graduated to read directly to 0.0001 in (or 0.002 mm). If capable of making more than one revolution, it must be equipped with a separate indicator to indicate the number of complete revolutions. The dial indicator mechanism should be fully jeweled. The frame should be of sufficient rigidity that a load of 3 lbf (or 13 N) applied to the dial housing, exclusive of the weight or spindle presser foot, will not cause a change in indication on the dial of more than 0.001 in (or 0.02 mm).

The indicator reading must be repeatable to 0.00005 in (or 0.0012 mm) at zero setting.

Weight on probe head (total of anvil, weight, spindle, etc.) must be 4 oz (113.6 g).

o Electronic or motor-driven comparator with same specifications as above.

Steel tape rules recommended in Section 5.3.1.

T-square.

5.4.2. Preparation for Test

Gage blocks covering the range of thicknesses to be tested should be used to check the accuracy of either the micrometer or the comparator and should be maintained without rust, tarnish, or scratches. The micrometer or comparator should be operated in an atmosphere free from drafts and fluctuating temperature and should be allowed to stabilize at ambient room temperature before use.

Place the deadweight dial micrometer or comparator on a solid, level table, free from excessive vibration. Check the weight of the deadweight used with the spindle head. It should have a weight of about 3.6 oz.

If the dial does not read zero with nothing between the anvil and the spindle head, set it at zero. Raise and lower the spindle head or probe several times; it should indicate zero each time. If it does not, find and correct the cause before proceeding. The accuracy of the micrometer or comparator should be checked with appropriate thickness gages whenever the device is moved to a different location and at the beginning of each day's use of the device.

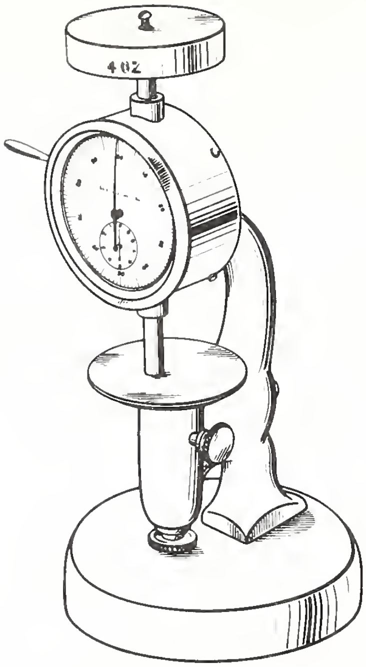

Figure 5-1. Deadweight dial micrometer.

5.4.3. Procedure

Steps 6a and 8a below apply to rolled product, 6b and 8b to folded product. Steps 10a and b apply to a two-stage MAV and, therefore, both steps 10a and 10b are followed for any single product test.

1. Determine inspection lot, fill out the standard pack report form heading (page A-1), and select the random sample and random tare sample.

   Check the label declaration to make sure that all the declared dimensions are consistent with one another:

   $W = T \times A \times 0.03613$, where
   W = net weight in pounds
   T = nominal thickness in inches
   A = nominal area; that is nominal length in inches times nominal width in inches
   D = density in grams per cubic centimeter as determined by ASTM Standard D1505-68 "Standard method of Test for Density of Plastics by the Density Gradient Technique" (or latest issue).

   0.03613 is a factor for converting g/cm^3 to lb/in^3.

   Assume a minimum density of 0.914 g/cm^3.

For example, if the label reads:

6 ft wide x 100 ft long

4 MIL

net weight 11.5 lb

$$W = (.004\ \text{in}) \times \left(100\ \text{ft} \times 12\ \frac{\text{in}}{\text{ft}}\right)$$

$$\times \left(6\ \text{ft} \times 12\ \frac{\text{in}}{\text{ft}}\right) \times 0.03613 \times .914$$

$$= 11.4\ \text{lb net weight}$$

Therefore, a declaration of 11.5 lb indicates that the label is in compliance.

Separate report forms for weight, length, width, and thickness should be attached to one another. The MAV for length and width dimensions is found in Table 2-11, page B-14. The MAV's for thickness are listed in Section 2.13. and in step 10a and b below. (If the actual length and width are correct, the area declaration is assumed correct.)

2. Gross weigh the packages chosen for tare, open them, and record the gross weights on the report form.

3. Weigh the first package tare (include core if any) and record on report form. Extend the first package to its full dimensions, and remove by hand all creases and folds as far as possible.

   Measure the length and width of the product to the closest 1/8 in (3 mm). Make all measurements at intervals uniformly distributed along the length and width of the product. Record the individual measurements on the worksheet for polyethylene (page A-11). Compute the average length and width and record on the worksheet.

   a. With rolls of product, make three length measurements along the width of the roll and at least ten width measurements along the length of the product.

   b. For folded products (such as drop cloths or tarpaulins), make three length measurements along the width of the sample and three width measurements along the length of the sample.

4. Follow Section 3.6. for determining conformance of the lot with net weight labeling requirements. If the lots fail to conform with net weight requirements, no further measurements are necessary.

5. Follow steps 4 through 12 of Section 5.3.2. to determine whether the inspection lot conforms with the package requirements on length and width. If the lot fails to conform, thickness need not be checked.

6. Measure the thickness of the plastic sheet with a micrometer or comparator at:

   a. five uniformly distributed locations across the width at each end and 5 locations along each side of each roll in the sample, or;

   b. five uniformly distributed locations across the width at one end and along the length at one side of folded product for each package in the sample.

   When measuring the thickness, place the sample between the micrometer or comparator surfaces and lower the spindle head or probe near, but outside, the area where the measurement will be made. Raise the spindle head or probe a distance of 0.0003 to 0.0004 in (or 0.008 to 0.01 mm) and move the sheet to the measurement position. Drop the spindle head onto the test area of the sheet. Read the dial thickness 2 seconds or more after the drop, or when the dial hand or digital readout becomes stationary. This procedure minimizes small errors that may occur when the spindle head or probe is lowered slowly onto the test area.

   For succeeding measurements, raise the spindle head or probe 0.0003 to 0.0004 in (or 0.008 to 0.01 mm) above the rest position on the test surface, move to the next measurement location, and drop the spindle head onto the test area. Take care to raise the spindle head or probe no more than 0.0004 in (or 0.01 mm) above its rest position on the test area. Any part of the test area in contact with the spindle head or probe during measurement must be at least 1/4 in (or 6 mm) from the edge of the sheet.

   Record all thickness measurements on the worksheet. Compute and record the average thickness for the individual package.

7. Repeat step 6 on the remaining packages in the sample.

8. In Section 2.13., the MAV for polyethylene was described to apply in two stages. Follow both a and b below.

    a. Measured thickness should not be less than 80% of the labeled thickness.

       Circle any value in the thickness columns of the worksheet that is smaller than (0.8 x labeled thickness). If the number of values circled exceeds the number recorded in box 8 of the report form, the lot fails to conform to requirements No further testing of the lot is necessary.

       If the number of circled thickness measurements is less than or equal to the box 8 value, go on to step 8b.

    b. The average thickness for any single package should be at least 93% of the labeled thickness.

       Circle any package average thickness value that is smaller than (0.93 x labeled thickness).

       If the number of package average thicknesses circled[1] exceeds the number recorded in box 8 of the report form, the lot fails to conform to requirements. No further testing of the lot is necessary. If the number of circled package average thicknesses is less than or equal to the box 8 value, follow step 8-11 of Section 3.5. (CORE METHOD) to determine lot conformance with respect to average thickness.

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[1] Count circled average thicknesses only; do not include circled individual thicknesses in this count.

5.5. PAPER PLATES[1]

The plate count is first checked against requirements for the average, then the plate size is checked.

5.5.1. Equipment

Scales and weights recommended in Section 3.1.

Measuring base of any flat, sturdy material approximately 15 in (or 40 cm) square. Two vertical side pieces approximately 1 in (or 3 cm) high and the same length as the sides of the measuring base are attached along two adjoining edges of the measuring base to form a 90° corner.

Graph paper, 20 divisions per inch (or 10 divisions per centimeter).

5.5.2. Preparation for Test

Trim all white borders from 2 or more sheets of graph paper. Place one sheet on the measuring base and position it so that one corner of graph paper is snug in the corner of the measuring base and vertical sides. Tape the sheet to the measuring base. Overlap other sheets on the first sheet so that the lines of top and bottom sheet coincide, expanding the graph area to a size bigger than the plates to be measured; these sheets are also taped to the measuring base. Number each inch (or centimeter) line from the top and left side of base plates: 1,2,3, etc.

5.5.3. Procedure

1. Determine inspection lot, fill out standard pack report forms (one for each labeled unit), and select random sample and random tare sample.

2. Follow the procedures in Section 5.1. or 5.2. (depending on the labeled count) to determine lot conformance with respect to count. If the lot conforms, go on to step 3 below.

3. The sample selected for determining lot conformance with respect to count may be used to determine conformance with respect to dimensions; however, the inspector may have to select additional packages for the sample. For example, if the lot size is between 251 and 500 packages, Table 5-1 (page B-22) permits a sample size of 10 packages for packages labeled by low count, but Table 2-5 requires a sample size of 30 packages for this lot size for checking dimensions.

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[1] Equipment and method derived from those provided by Mr. William Marks, American Can Co., 333 No. Commercial St., Neenah, WI 54956.

For low count packages, check sample size required according to Table 2-2 (page B-3) or 2-5 (page B-5) and, if necessary, select additional packages for the sample. A tare sample is not needed in this part of the procedure.

Select one plate from each package to represent that package[1].

4. Place each plate to be measured on the measuring base plate, eating surface down, so that two sides of the plate are touching the two vertical side pieces (See Figure 5-2.)

   Rest the palm of your hand on the plate to ensure that plate is flat and, referring to the numbered lines on the graph paper, read the plate diameter. If the plate is circular, read the smallest diameter if the numbers in the two directions differ. If the plate is oblong, read the plate size in major and minor directions.

5. The package error is equal to the plate diameter minus the labeled diameter. Record the package error on a worksheet and, using an appropriate unit of measure, transfer to a report form (separate from the form used to record count).

6. Repeat steps 4 and 5 for all packages in the sample. Follow steps 7-11 of section 3.5. (CORE METHOD) to determine lot conformance.

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[1] Some packages of plates contain a combination of plates of differing sizes. In this instance, a plate of each declared size is taken from the package to represent all the plates of that size in the package. For example, if three sizes are declared, three plates are selected from each package. Upon occasion, packages of plates declared to be of one size may contain plates which can be seen by inspection to be of different sizes in the same package. In this instance, select the smallest plate and using the methods above, determine the package error for the smallest. If the smallest plate is not short measure by more than the MAV, each size of plate in the package will have to be checked and the average dimensions of the package calculated. For example, if 5 plates measure 8 7/16 in and 15 measure 8 9/16 in, the average dimension for this package of 20 plates is 8.53 in.

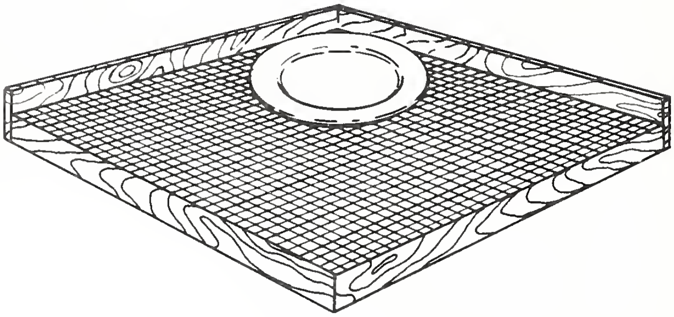

Figure 5-2. Preparing to measure the dimensions of a paper plate.

5.6. SANITARY PAPER PRODUCTS[1]

The labeled count is first checked, followed by a check on the linear measurements.

The count of sanitary paper products cannot be determined adequately by weighing. Variability in sheet weight and core weight requires that official tests be conducted by actual count. Weighing can be a useful audit method, however.

These products often declare total area as well as unit count and sheet size declarations. If the actual sheet size measurements and the actual count comply with the average requirements, the total area declaration is assumed to be correct.

5.6.1. Equipment

Plastic plate, 1/8 to 1/2 in (or 0.3 to 2 cm) thick, 20 by 20 in (or 50 by 50 cm).

Rule, 12 in (or 30 cm) in length, 0.02 in (or 1 mm) divisions.

It is easier to make the measurements if two rules are inlaid perpendicular to each other and flush with a working surface.

---

[1] Derived from apparatus and method by Mr. William Marks, American Can Co., Neenah, WI 54956.

5.6.2. Procedure

1. Determine inspection lot, fill out separate forms for length, count, and width. Follow the procedures in Section 5.1. or 5.2. to determine lot conformance with count requirements.

2. If necessary, select additional packages for the sample to be checked for dimensions (as in Section 5.5.3., step 2). A tare sample is not necessary.

3. Select one sheet, napkin, etc. from each package. Then, (removing creases if necessary), place the product between the working surface and the plastic plate and measure and record the product's dimensions.

4. The package error is equal to the actual dimension minus the labeled dimension. Record the package errors on a worksheet and, using an appropriate unit of measure, transfer them to a different report form than used to record count.

5. Repeat steps 3 and 4 for all the packages in the sample. Go to step 7 of Section 3.5. (CORE METHOD) to determine lot conformance.

6. Individual sheets within a package or roll may differ from one another. If the above procedure indicates lot non-conformance, measure at least 10 sheets selected randomly from each package. Average these to determine dimensions and use these average dimensions in steps 4 and 5 above.

5.7. PRESSED AND BLOWN GLASS TUMBLERS AND STEMWARE

The package requirement that the average quantity of a lot (shipment or delivery) meet or exceed the labeled quantity is not applied to the capacity of pressed and blown tumblers and stemware[1]. When a tolerance is provided in a regulation, a minimum net quantity is defined for the packages in the lot. If any and all packages in a lot are allowed to be less than the declared quantity by a specified amount, then the average net quantity of those packages cannot be expected to meet some higher value.

The sampling plans in Table 5-2 (page B-23) are provided for pressed and blown glass tumblers and stemware.

To use the sampling plans in Table 5-2 the inspection lot is identified and a random sample (following Appendix E methods) is selected according to the size of the lot.

The capacity of the items in the sample are measured following Section 5.7.1. Each package error is compared with the applicable allowable difference. The number of packages with package errors greater than the allowable difference is counted and compared with the number given in column 4 of Table 5-2. If the number in column 4 is exceeded, the lot fails to conform with the package requirements. If the number of packages with errors exceeding the allowable difference is less than or equal to the number in column 4, the lot conforms. The average package error is not calculated. The lot conforms or fails based on the individual package errors only. Individual packages containing items exceeding the allowable difference are acted upon individually even though the requirements for the lot may be met.

---

[1] The National Conference on Weights and Measures (NCWM) Uniform Method of Sale of Commodities Regulation (MoS) is a standard for State regulatory use which is periodically updated by State agency representatives. The 1983 edition of NBS Handbook 130, which contains the current NCWM uniform regulations, lists the following "allowable differences" or tolerances. Individual State regulations may or may not permit the following or other allowable differences.

Product	Allowable difference	Reference to the NCWM MoS
pressed and blown tumblers and stemware labeled by count and capacity	inch-pound: ± 1/4 oz for items less than or equal to 5 oz; ± 5% for items greater than 5 oz. metric: ± 10 mL for items less than or equal to 200 mL; ± 5% for items greater than 200 mL.	Section 3.2.1.

5.7.1. Procedure

This section describes how to test tumblers and stemware which are labeled by count and capacity. The package count must meet the requirements for the average. The individual units (tumblers, stemware) must meet the requirements for capacity, which for pressed and blown products is an "allowable difference" requirement. Equipment is the same as recommended in Section 4.14.1.

1. Determine inspection lot, and follow the procedures in Section 5.1. or 5.2. (depending on the labeled count) to determine conformance of the lot with respect to count.

   If the lot conforms to requirements for count, go on to step 2 below.

2. The packages selected for the sample to be tested for count may also be used to test for capacity. Since a different sampling plan will be used, a different sample size may be needed.

   For example, an inspection lot of 7 oz, 12 count, glass tumblers is composed of 500 packages. Referring to Table 5-1 (page B-22), a sample size of 10 is selected to be checked for count. The lot is found to conform to the average requirements for count. Referring to Table 5-2 (page B-23), a sample size of 10 is adequate for checking the labeled capacity. Therefore, the same 10 packages are checked for capacity.

   Every package is checked. (No tare sample is needed.)

   The capacity of each container in the package is determined.

3. Follow Section 4.14.2., steps 2, 3, and 4 on each item to be checked. Use separate worksheets amd report form from those used to record labeled count.

4. The tumbler error is equal to the measured volume capacity minus the labeled capacity. Note on the report form to refer to the worksheet(s) for the appropriate individual tumbler error.

5. Compare each tumbler/stemware error with the allowable difference. Circle any error that exceeds the allowable difference (either positive or negative error).

6. Compare the total number of circled errors with Table 5-2, column 4 value, corresponding to the sample size.

   For example, if the sample size is 30, only one tumbler/stemware error in the sample may exceed the allowable difference.

   If the number of circled errors is more than the column 4 value of Table 5-2, the lot fails to conform to the package requirements. If the number of circled errors is less than or equal to the value in Column 4 of Table 5-2, the lot conforms with the package requirements.

ACKNOWLEDGMENTS

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APPENDIX A. FORMS AND WORKSHEETS

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DATE

STANDARD PACK REPORT FORM

REPORT NUMBER

Location of TEST (Name, Address)	☐ Retailer ☐ Wholesaler ☐ Packager	PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION
		1 LABELED CONTENTS	2 UNIT OF MEASURE ☐ lb. ☐ oz.	3 MAV (same units as label)	4 MAV (dimensionless units)

5 LOT SIZE (N)	a GROSS WEIGHT					
	b TARE WEIGHT					
6 SAMPLE SIZE (n) ☐ A (p. B-3) ☐ B (p. B-5)	c NET WEIGHT					
7 TARE SAMPLE SIZE ☐ Alternative (p. B-6)	d PACKAGE ERROR $\boxed{a} - \boxed{14}$					
8 Allowed Number UNREASONABLE ERRORS	e PACKAGE ERROR (dimensionless units) $\boxed{d} \div \boxed{2}$					

9 R_C (see $\boxed{c}$) Range of Net Weights	10 R_T (see $\boxed{b}$) Range of TARE Weights	11 $R_C \div R_T =$ $\boxed{9} \div \boxed{10} =$	12 n_t (Table 2-7, p. B-7&8)	13 AVERAGE TARE ☐ dry ☐ wet ☐ alternative	13a TARE CORRECTION ☐ Moisture ☐ Foam (p. B-17) ☐ Vacuum Pack	14 NOMINAL GROSS WEIGHT $\boxed{1} + \boxed{13} + \boxed{13a} =$	

PACKAGE ERRORS

										TOTALS (−)	TOTALS (0/+)
+ −											
RANGES										15 TOTAL ERROR	

16 NO. UNREASONABLE MINUS ERRORS	17 IS $\boxed{16}$ Greater than $\boxed{8}$ ☐ YES: LOT FAILS ☐ NO—CONTINUE	18 AVERAGE ERROR (Dimensionless Units) $\boxed{15} \div \boxed{6} =$	19 AVERAGE ERROR (labeled units)	20 IS $\boxed{18}$ ZERO OR PLUS? ☐ NO→☐ Cat. B, Lot Fails ☐ Cat. A, go to $\boxed{21}$ ☐ YES→LOT PASSES
21 AVERAGE RANGE	22 Use $\boxed{6}$ to look up value in Table 2-3, Col 2 (p. B-3)	23 $d = \boxed{21} \times \boxed{22} =$	24 $(n/N) \times 100 =$ $(\boxed{6} \div \boxed{5}) \times 100 =$	25 Use $\boxed{24}$ to look up f in Table 2-4 (p. B-4) f =
				26 $T = \boxed{23} \times \boxed{25} =$

27 Disregarding the signs, is $\boxed{18}$ larger than $\boxed{26}$? ☐ Yes→lot fails ☐ No→lot passes

28 DISPOSITION OF LOT: ☐ Approved ☐ Rejected

Comments:

Acknowledged Receipt of Report

Official

DATE

RANDOM PACK REPORT FORM
(Page 1 of 2)

REPORT NUMBER

LOCATION OF TEST (Name, Address)
☐ Retailer
☐ Wholesaler
☐ Packager

1 LOT SIZE (N)

2 SAMPLE SIZE (n)
☐ A (p B-3)
☐ B (p B-5)

3 TARE SAMPLE SIZE
☐ alternative (p B-6)

4 ALLOWED NUMBER OF UNREASONABLE ERRORS

5 UNIT OF MEASURE (size of scale div.)
☐ lb
☐ oz

TARE ☐ DRY ☐ WET (page 2 for alternative)

7 PRODUCT DESCRIPTION, LOT CODE UNIT PRICE	8 LABELED WEIGHT	9 PACKAGE ERROR –	0/+	10 MAV (Weight) (p B-9&10)	11 MAV (Scale div) 10 ÷ 5

12 TOTAL ERROR

13 NUMBER OF MINUS PACKAGE ERRORS EXCEEDING MAV

	PACKAGE 1	PACKAGE 2
TARE 1		
6 AVERAGE TARE		
TARE 2		
6 AVERAGE TARE		
TARE 3		
6 AVERAGE TARE		
TARE 4		
6 AVERAGE TARE		

LOT DISPOSITION
(B only; see page 2 for A)

14 IS 13 GREATER THAN ZERO?
☐ YES → LOT FAILS
☐ NO → CONTINUE

15 AVERAGE ERROR = TOTAL ERROR ÷ NO. OF PACKAGES
= 12 ÷ 2

16 AVERAGE ERROR in units of weight = AVERAGE ERROR in Scale div × UNIT OF MEASURE
= 15 × 5
=

17 IS AVERAGE ERROR 0/+ ?
☐ YES → LOT PASSES
☐ NO → LOT FAILS

18 ☐ LOT ACCEPTED ☐ LOT REJECTED

COMMENTS:

Acknowledged Receipt of Report

Official

RANDOM PACK REPORT FORM
Page 2 of 2

REPORT NUMBER

ALTERNATIVE TARE CALCULATIONS:

a GROSS WEIGHT							
b TARE WEIGHT							6b R_T =
c NET WEIGHT							6a R_C =
d PACKAGE ERROR a − 6e − 8							6c $R_C \div R_T$ = 6b ÷ 6a
e PACKAGE ERROR (in scale div) d ÷ 5							6d n_t (Table 2-7 p B-7&8)
Additional Tare weights:	GROSS WT						6e AVERAGE TARE
	TARE WT						

LOT DISPOSITION CATEGORY A

NOTE: PACKAGES SHOULD NOT BE ARRANGED FROM LIGHTEST TO HEAVIEST WHEN FOLLOWING A

19

ON PAGE 1,
THE NUMBER OF MINUS PACKAGE ERRORS EXCEEDING THE MAV IS RECORDED IN BOX 13

BOX 4 CONTAINS THE ALLOWED NUMBER.

IS 13 Greater than 4 ?

☐ YES → LOT FAILS
☐ NO → GO TO 20

20 AVERAGE ERROR (Scale div) = TOTAL ERROR ÷ NO. OF PACKAGES
= 12 ÷ 2
=

21 AVERAGE ERROR in units of weight = AVERAGE ERROR in no. of scale div. × UNIT OF MEASURE
= 20 × 5
=

22 IS 20 MINUS?
☐ NO → LOT PASSES
☐ YES → GO TO 23

23

GROUP	RANGE OF PACKAGE ERRORS FOR EACH GROUP OF 5 PACKAGES
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

24 AVERAGE R = SUM OF R ÷ NO. OF GROUPS

$\bar{R}$ =

25 TABLE 2-3
Col. 2 value (page B-3)

26 d = 24 × 25
=

27 (n/N) × 100 =
(2 ÷ 1) × 100 =

28 Use 27 to look up f in Table 2-4 (page B-4) f =

29 T = 26 × 28
=

DISREGARDING THE SIGNS,
IS 20 larger than 29 ?
☐ Yes → Lot Fails
☐ No → Lot Passes

Record final lot disposition on page 1 in box 18

WORKSHEET FOR PACKAGES LABELED BY LIQUID VOLUME

NUMBERS WITH BOXES (e.g. $\boxed{3}$) REFER TO REPORT FORM (page A-1)
STEP NUMBERS (e.g. STEP 5) REFER TO WORKSHEET

Fill out report form up through box $\boxed{8}$, skip boxes $\boxed{3}$ and $\boxed{4}$.

		(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight						
2. Tare Weight	*R_C =					
Net Weight	*R_T =					
3. Flask Weight (full)						
4. Flask Weight (empty, wetted)						
5. Weight of Liquid (Step 3 – Step 4)						
6. Volume of Flask						
7. Temperature of Liquid						

8. Do the weights recorded in Step 5 differ from each other by more than the value in Table 4-3 (page B-20)?

YES ☐ If this box is checked, open all packages in sample and determine each package error by volume (see Section 4.6.).

NO ☐ If this box is checked, continue below.

9. AVERAGE WEIGHT OF LIQUID IN FLASK = AVERAGE OF STEP 5 = ☐

10. AVERAGE WEIGHT OF LABELED VOLUME $= \frac{\text{LABELED VOLUME}}{\text{FLASK VOLUME}} \times$ AVG. WEIGHT OF LIQUID IN FLASK

$= \frac{\text{box } \boxed{1}}{\text{Step 6}} \times \text{Step 9} =$ ☐

*11. (R_C/R_T = ________) (n_t = ________)‡

12. AVERAGE TARE = AVERAGE OF STEP 2 (or average of Step 2 and additional tares)*

= ☐ Record in box $\boxed{13}$ on report form

*Alternative Tare procedure for liquids packed in glass.

‡If additional packages are opened for tare, provision should be made for recording all pertinent data.

13. NOMINAL GROSS WEIGHT = AVERAGE TARE + AVERAGE WEIGHT OF LABELED VOLUME

= Step 12 + Step 10 = ☐

Record in box $\boxed{14}$ on report form

14. For packages opened for Tare:

PACKAGE ERROR (weight) = GROSS WEIGHT − NOMINAL GROSS WEIGHT

= Step 1 − Step 13

=

1	2	3	4	5

15. PACKAGE ERROR (dimensionless units) = PACKAGE ERROR (weight) ÷ UNIT OF MEASURE

= Step 14 ÷ box $\boxed{2}$

=

1	2	3	4	5

Record package errors on report form in crosshatched area.

16. MAV (volume) from Table 2-9 (pages B-11&12) = ☐ Record in box $\boxed{3}$ on report form.

17. MAV (weight) = MAV (volume) × $\dfrac{\text{AVERAGE WEIGHT OF LABELED VOLUME}}{\text{LABELED VOLUME}}$

= Step 16 × $\dfrac{\text{Step 10}}{\text{box } \boxed{1}}$ = ☐

18. MAV (dimensionless units) = MAV (weight) ÷ UNIT OF MEASURE

= Step 17 ÷ box $\boxed{2}$ = ☐ Record in box $\boxed{4}$ on report form

19. Compare unopened packages with nominal gross weight (Step 13, box $\boxed{14}$).

Record package errors for remaining packages in sample directly on report form in crosshatched area.

Compare minus package errors with MAV (Step 18, box $\boxed{4}$).

Average package errors (box $\boxed{18}$). Convert back to units of volume as given below:

AVERAGE PACKAGE ERROR (volume) = AVG. PACKAGE ERROR (dimensionless units) × UNIT OF MEASURE × $\dfrac{\text{LABELED VOLUME}}{\text{AVG. WEIGHT OF LABELED VOLUME}}$

= box $\boxed{18}$ × box $\boxed{2}$ × $\dfrac{\text{box } \boxed{1}}{\text{Step 10}}$

= ☐ Record in box $\boxed{19}$ on report form

(Boxes above with "3", "4", "5" in corners are for larger tare sample sizes.)

WORKSHEET FOR CHECKING PAINT

Audit

① Can Height	Can Diameter				⑥ Average Liquid Diameter	⑦ Average Liquid Level	⑧ Average Container Depth	⑨ Average Liquid Depth	⑩ Volume
	② Top	③ Middle	④ Bottom	⑤ Average					

1 cu. in. = 0.004329 gal.

1 cm^3 = 0.001 L

Volume ⑩ = 0.7854 x ⑥ x ⑥ x ⑨

If volume in ⑩ is less than labeled volume, use possible violation procedures (Section 4.9.4.)

Possible Violation

① Label	② Gross Weight	③ Lid Weight Wet (-) Dry	④ Liquid Level	⑤ Tare	⑥ Water Volume	⑦ Net Weight = ② - ⑤	⑧ Weight of Label Volume $= \frac{\textcircled{7} \times \textcircled{1}}{\textcircled{6}}$	⑨ Package Volume $= \textcircled{6} + \left[\frac{\textcircled{3}}{\textcircled{7}} \times \textcircled{6}\right]$

WORKSHEET FOR PACKAGES LABELED BY COUNT

NUMBERS WITH BOXES (e g $\boxed{3}$) REFER TO REPORT FORM (page A-1)
STEP NUMBERS (e g "Step 5") REFER TO WORKSHEET

Fill out report form through box $\boxed{8}$, skip boxes $\boxed{3}$ and $\boxed{4}$

	(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight					
2. Tare Weight					
3. Count in Each Package					
4. Weight of Counted Items					
5. Weight of Labeled Count $= \text{Labeled Count} \times \frac{\text{Step 4}}{\text{Step 3}} =$					

6. MAV (count) from Table 2-10 (page B-13) = ☐ Record in box $\boxed{3}$ on the report form

7. MAV/6 (weight) = MAV/6 (count) × $\dfrac{\text{WEIGHT OF COUNTED ITEMS}}{\text{COUNT IN PACKAGE}}$

$$= \frac{\text{Step 6}}{6} \times \frac{\text{Step 4 (for first package)}}{\text{Step 3 (for first package)}} = \boxed{}$$

8. *If using an equal-arm package checking scale*, is value calculated in Step 7 equal to or larger than ½ the smallest graduation?

If using an electronic package checking scale, is value calculated in Step 7 at least as large as the smallest increment?

NO ☐ If this package is checked, open all packages in sample and determine each package error by actually counting the items inside the packages.

YES ☐ If this box is checked, continue below.

9. Do the weights recorded in Step 5 above differ from each other by more than the value in Table 4-3 (page B-20)?

YES ☐ If this box is checked, open all packages in sample and determine each package error by counting items inside packages.

NO ☐ Average Weight of Labeled Count = average of Step 5 = ☐

10. AVERAGE TARE = AVERAGE OF STEP 2 = ☐ Record in box $\boxed{13}$ on report form.

11. NOMINAL GROSS WEIGHT = AVERAGE TARE + AVERAGE WEIGHT OF LABELED COUNT

= Step 10 + Step 9 = ☐

Record in box $\boxed{14}$ on report form.

12. For packages opened for Tare:

$$\underset{\text{(weight)}}{\text{PACKAGE ERROR}} = \text{GROSS WEIGHT} - \text{NOMINAL GROSS WEIGHT}$$

$$= \text{Step 1} - \text{Step 11}$$

=

1	2	3	4	5

13. $$\underset{\text{(dimensionless units)}}{\text{PACKAGE ERROR}} = \underset{\text{(weight)}}{\text{PACKAGE ERROR}} \div \text{UNIT OF MEASURE}$$

$$= \text{Step 12} \div \text{box } \boxed{2}$$

=

1	2	3	4	5

Record these package errors on report form in crosshatched area.

14. $$\underset{\text{(weight)}}{\text{MAV}} = \underset{\text{(count)}}{\text{MAV}} \times \frac{\text{AVERAGE WEIGHT OF LABELED COUNT}}{\text{LABELED COUNT}}$$

$$= \text{Step 6} \times \frac{\text{Step 9}}{\text{box } \boxed{1}} = \boxed{}$$

15. $$\underset{\text{(dimensionless units)}}{\text{MAV}} = \underset{\text{(weight)}}{\text{MAV}} \div \text{UNIT OF MEASURE}$$

$$= \text{Step 14} \div \text{box } \boxed{2} = \boxed{}$$ Record in box $\boxed{4}$ on report form

16. Compare unopened packages with nominal gross weight (Step 11 or box $\boxed{14}$).

Record package errors for remaining packages in sample directly on report form in crosshatched area.

Compare minus package errors with MAV (Step 15 or box $\boxed{4}$).

Average package errors (box $\boxed{18}$). Convert back to units of count as given below:

$$\underset{\text{(count)}}{\text{AVERAGE PACKAGE ERROR}} = \underset{\text{(dimensionless units)}}{\text{AVG. PACKAGE ERROR}} \times \text{UNIT OF MEASURE} \times \frac{\text{LABELED COUNT}}{\text{AVG. WEIGHT OF LABELED COUNT}}$$

$$= \text{box } \boxed{18} \times \text{box } \boxed{2} \times \frac{\text{box } \boxed{1}}{\text{Step 9}}$$

$$= \boxed{}$$ Record in box $\boxed{19}$ on report form.

(Boxes above with "3", "4", and "5" in corners are for larger tare sample sizes).

WORKSHEET FOR CHECKING POLYETHYLENE SHEETING

Labeled Length
Labeled Width
Labeled Thickness

0.8 × Labeled Thickness Compare with All Thickness Measurements
0.93 × Labeled Thickness Compare with Average Package Thickness

Package	Length	Width		Thickness				Package	Length	Width		Thickness			
Package Average								▨							
Package Average								▨							
Package Average								▨							
Package Average								▨							
Package Average								▨							
Sample Average															

APPENDIX B. TABLES

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Table 4-2 Recommended maximum units of measure to be used for recording the weights of packaged goods labeled by liquid volume B-19

Table 4-3 Maximum permitted difference in weights of two equal quantities according to the type of scale used to weigh B-20

Table 4-4 Thickness of paint can walls and labels B-21

Table 5-1 Sampling plans for packages labeled by low count B-22

Table 5-2 Sampling plans for packages given tolerances B-23

Table 1-1. Agencies responsible for package regulations.[*]

Agency	Product
U.S. Department of Agriculture, Food Safety and Quality Service	meat and poultry
U.S. Department of Health and and Human Services, Food and Drug Administration	food, drugs, cosmetics, and medical devices
U.S. Federal Trade Commission	household or consumer commodities that are not food, drugs, medical devices, or cosmetics
U.S. Environmental Protection Agency	pesticides
U.S. Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms	alcohol and tobacco products
State Weights and Measures Offices	all packaged products

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[*] See Appendix D for specific regulations.

Table 2-1. Guide to locations on the report form for standard pack packages on page A-1.

Box	Subject	Section	Page
1	Labeled Contents	2.2.1.	2-2
2	Unit of Measure	2.9.1.	2-16
3	Maximum Allowable Variation (MAV)	2.12.	2-27 & B-9 to B-15
4	MAV (dimensionless units)	2.9.1.	2-16
5	Lot Size (N)	2.3.3	2-8
6	Sample Size (n)	2.6., 2.7.	2-9, 2-14
7	Tare Sample Size (n_t)	2.6., 2.7., 2.11.4.	2-9, 2-14, 2-23
8	Allowed Number of Unreasonable Errors	2.6.1., 2.7.1.	2-10, 2-14
9	Range of Net Weights (R_c)	2.11.4.	2-25
10	Range of Tare Weights (R_t)	2.11.4.	2-25
11	R_c : R_t	2.11.4.	2-25
12	n_t from Table 2-7	2.11.4.	2-25
13	Average Tare	2.11., 2.11.3., 2.11.4	2-20, 2-23 2-26
13a	Tare Correction	moisture 2.14., foam 3.11.6., vacuum pack 3.15.	2-29 3-37 3-42
14	Nominal Gross Weight	3.5.	3-7
15	Total Package Error	2.9.3.	2-18
16	Actual Number of Unreasonable Errors	2.6.1., 2.7.1	2-10, 2-14
17	Decision on Unreasonables	2.6.1., 2.7.1.	2-10, 2-14
18	Average Error (dimensionless units)	2.6.2., 2.7.2.	2-11, 2-15
19	Average Error (labeled units)	2.6.2., 2.7.2.	2-11, 2-15
20	Decision on Average	2.6.2., 2.7.2.	2-11, 2-15
21	Average Range	2.6.2., Appendix H	2-11, H-1
22	Value from Table 2-3, column 2	2.6.2.	2-12
23	d	2.6.2.	2-12
24	(n/N) x 100	2.6.2.	2-13
25	f	2.6.2.	2-13, B-4
26	T	2.6.2.	2-13
27	Decision on Average (for Cat. A only)	2.6.2.	2-14
28	Disposition of Lot	Summary of boxes 17, 20, 27	2-4

Table 2-2. Sampling plans of Category A.

1	2	3	4
Lot size (number of packages in lot) N	Sample size (number of packages in sample) n	Tare sample size[a] (number of packages chosen for tare determination) n_t	Number of minus package errors allowed to exceed the MAV[b]
30 or less	all	2	0
31-800	30	2	1
801-2,000	50	5	2
2,001-5,000	80	5	3
5,001-15,000	125	5	5
15,001 and greater	200	10	7

[a] Special rules for tare sampling apply when Section 2.11.4. is followed (this is the tare procedure for variable tare and must be used for glass or aerosol packages).

[b] See Tables 2-8 through 2-11 (pages B-9 to B-14), and Sections 2.12. and 2.13.

Table 2-3. Values of $\frac{0.8598}{\sqrt{n}}$ and $\frac{2}{\sqrt{n}}$ for sample size n.

1	2	3
n sample size	$\frac{0.8598}{\sqrt{n}}$ used only when $\overline{R}$ is calculated	$\frac{2}{\sqrt{n}}$ used only when s is calculated
30	0.1570	0.3652
50	0.1216	0.2828
80	0.09613	0.2236
125	0.07691	0.1789
200	0.06080	0.1414

Table 2-4. Values of f for percent of lot sampled *

Percent of lot sampled	f	Percent of lot sampled	f	Percent of lot sampled	f
1	.99	36	.80	71	.54
2	.99	37	.79	72	.53
3	.98	38	.79	73	.52
4	.98	39	.78	74	.51
5	.97	40	.77	75	.50
6	.97	41	.77	76	.49
7	.96	42	.76	77	.48
8	.96	43	.75	78	.47
9	.95	44	.75	79	.46
10	.95	45	.74	80	.45
11	.94	46	.73	81	.44
12	.94	47	.73	82	.42
13	.93	48	.72	83	.41
14	.93	49	.71	84	.40
15	.92	50	.71	85	.39
16	.92	51	.70	86	.37
17	.91	52	.69	87	.36
18	.91	53	.69	88	.35
19	.90	54	.68	89	.33
20	.89	55	.67	90	.32
21	.89	56	.66	91	.30
22	.88	57	.66	92	.28
23	.88	58	.65	93	.26
24	.87	59	.64	94	.24
25	.87	60	.63	95	.22
26	.86	61	.62	96	.20
27	.85	62	.62	97	.17
28	.85	63	.61	98	.14
29	.84	64	.60	99	.10
30	.84	65	.59	100	0
31	.83	66	.58		
32	.82	67	.57		
33	.82	68	.57		
34	.81	69	.56		
35	.81	70	.55		

*Percent of lot sampled = $\frac{\text{sample size}}{\text{lot size}} \times 100 = \frac{n}{N} \times 100$

Table 2-5. Sampling plans of Category B.

1 Lot size (number of packages in lot) N	2 Sample size (number of packages in sample) n	3 Tare sample size[a] (number of packages chosen for tare determination) n_t	4 Number of minus package errors allowed to exceed the MAV[b]
Up to and including 250	10	2	0
251 and greater	30	2	0

[a] Special rules for tare sampling apply when Section 2.11.4. is used (glass or aerosol packages).

[b] See Tables 2-8 through 2-11 (pages B-9 to B-14), Sections 2.12. and 2.13.

Table 2-6. Initial tare sample size for alternative tare procedures.

Sampling plan Category	Lot size	Initial tare sample size
A	all	5 packages
B	equal to or less than 250 packages	2 packages
	greater than 250 packages	5 packages

Table 2-7. Total number* of packages (n_t) to be opened for tare determination.

Ratio R_c/R_t	number of packages in sample					
	n=10	n=30	n=50	n=80	n=125	n=200
	n_t	n_t	n_t	n_t	n_t	n_t
0.2 OR LESS	10	30	50	80	125	200
0.21 - 0.40	10	29	49	77	121	193
0.41 - 0.60	10	28	46	74	115	184
0.61 - 0.80	9	26	44	69	108	173
0.81 - 1.00	8	24	40	64	100	160
1.01 - 1.20	8	23	37	59	92	148
1.21 - 1.40	7	21	34	54	84	135
1.41 - 1.60	7	19	31	49	77	122
1.61 - 1.80	6	17	28	45	69	111
1.81 - 2.00	5	15	25	40	63	100
2.01 - 2.20	5	14	23	37	57	91
2.21 - 2.40	5	13	21	33	52	82
2.41 - 2.60	4	12	19	30	47	75
2.61 - 2.80	4	11	17	28	43	68
2.81 - 3.00	4	10	16	25	39	62
3.01 - 3.20	3	9	15	23	36	57
3.21 - 3.40	3	8	13	21	32	52
3.41 - 3.60	3	8	12	19	30	48
3.61 - 3.80	3	7	11	18	28	44
3.81 - 4.00	2	6	10	16	25	40
4.01 - 4.20	2	6	10	15	24	37
4.21 - 4.40	2	6	9	14	22	35
4.41 - 4.60	2	5	8	13	20	32
4.62 - 4.80	2	5	8	12	19	30
4.81 - 5.00	2	5	7	12	18	28
5.01 - 5.20	2	4	7	11	17	26
5.21 - 5.40	2	4	7	10	16	25
5.41 - 5.60	2	4	6	10	15	23
5.61 - 5.80	2	4	6	9	14	22
5.81 - 6.00	2	3	5	8	13	20

* Including those already opened for initial tare determination.

Table 2-7 (continued). Total number* of packages (n_t) to be opened for tare determination.

Ratio R_c/R_t	number of packages in sample					
	n=10	n=30	n=50	n=80	n=125	n=200
	n_t	n_t	n_t	n_t	n_t	n_t
6.01 - 6.20	2	3	5	8	12	19
6.21 - 6.40	2	3	5	8	12	19
6.41 - 6.60	2	3	5	7	11	17
6.61 - 6.80	2	3	5	7	10	16
6.81 - 7.00	2	3	5	7	10	16
7.01 - 7.20	2	3	5	6	9	15
7.21 - 7.40	2	3	5	6	9	14
7.41 - 7.60	2	2	5	6	9	13
7.61 - 7.80	2	2	5	5	8	13
7.81 - 8.00	2	2	5	5	8	12
8.01 - 8.20	2	2	5	5	8	12
8.21 - 8.40	2	2	5	5	7	11
8.41 - 8.60	2	2	5	5	7	11
8.61 - 8.80	2	2	5	5	7	10
8.81 - 9.00	2	2	5	5	6	10
9.01 - 9.20	2	2	5	5	6	10
9.21 - 9.40	2	2	5	5	6	10
9.41 - 9.60	2	2	5	5	6	10
9.61 - 9.80	2	2	5	5	5	10
9.81 - 10.00	2	2	5	5	5	10
10.01 - 10.20	2	2	5	5	5	10
10.21 - 10.40	2	2	5	5	5	10
10.41 - 10.60	2	2	5	5	5	10
10.61 - 10.80	2	2	5	5	5	10
10.81 - 11.00	2	2	5	5	5	10
11.01 - 11.20	2	2	5	5	5	10

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[*] Including those already opened for initial tare determination.

Table 2-8. MAV's for an individual package labeled by weight[a].

Avoirdupois units			Metric units	
Labeled weight	MAV		Labeled weight	MAV
Pounds or ounces	Decimal pounds	Fractional ounces	Grams	Grams
up to and including 0.08 lb up to and including 1.28 oz	10% of labeled weight		up to and including 36	10% of labeled weight
0.08+[b] to[c] 0.12 lb 1.28+ to 1.92 oz	0.008	1/8	36+ to 54	4
0.12+ to 0.18 lb 1.92+ to 2.88 oz	0.012	3/16	54+ to 82	5
0.18+ to 0.26 lb 2.88+ to 4.16 oz	0.016	1/4	82+ to 118	7
0.26+ to 0.34 lb 4.16+ to 5.44 oz	0.020	5/16	118+ to 154	9
0.34+ to 0.46 lb 5.44+ to 7.36 oz	0.024	3/8	154+ to 209	11
0.46+ to 0.58 lb 7.36+ to 9.28 oz	0.028	7/16	209+ to 263	13
0.58+ to 0.70 lb 9.28+ to 11.20 oz	0.032	1/2	263+ to 318	15
0.70+ to 0.84 lb 11.20+ to 13.44 oz	0.036	9/16	318+ to 381	16
0.84+ to 0.94 lb 13.44+ to 15.04 oz	0.040	5/8	381+ to 426	18
0.94+ to 1.08 lb 15.04+ to 17.28 oz	0.044	11/16	426+ to 490	20
1.08+ to 1.26 lb	0.048	3/4	490+ to 572	22
1.26+ to 1.40 lb	0.052	13/16	572+ to 635	24
1.40+ to 1.54 lb	0.056	7/8	635+ to 698	25
1.54+ to 1.70 lb	0.060	15/16	698+ to 771	27

[a] Applies only to shortages in package weight (that is, the MAV is compared with minus package errors only)

[b] 0.08+ means "greater than 0.08"

[c] "to" means "to and including"

Table 2-8. (continued) MAV's for an individual package labeled by weight.

Avoirdupois units			Metric units	
Labeled weight	MAV		Labeled weight	MAV
Pounds	Decimal pounds	Fractional ounces	Grams or kilograms	Grams
1.70+ to 1.88	0.064	1	771+ to 852	29
1.88+ to 2.14	0.070	1 1/8	852+ to 971	32
2.14+ to 2.48	0.078	1 1/4	971+ to 1.125	35
2.48+ to 2.76	0.086	1 3/8	1.125+ to 1.350	40
2.76+ to 3.20	0.094	1 1/2	1.350+ to 1.600	45
3.20+ to 3.90	0.11	1 3/4	1.600+ to 1.800	50
3.90+ to 4.70	0.12	2	1.800+ to 2.100	55
4.70+ to 5.80	0.14	2 1/4	2.100+ to 2.640	65
5.80+ to 6.80	0.15	2 1/2	2.640+ to 3.080	70
6.80+ to 7.90	0.17	2 3/4	3.080+ to 3.800	80
7.90+ to 9.40	0.19	3	3.800+ to 4.400	85
9.40+ to 11.70	0.22	3 1/2	4.400+ to 5.200	100
11.70+ to 14.30	0.25	4	5.200+ to 6.800	115
14.30+ to 17.70	0.28	4 1/2	6.800+ to 8.20	130
17.70+ to 23.20	0.31	5	8.20+ to 10.60	145
23.20+ to 31.60	0.37	6	10.60+ to 14.30	170
31.60+ to 42.40	0.44	7	14.30+ to 19.25	200
42.40+ to 54.40	0.50	8	19.25+ to 24.70	230
54.40+	2% of labeled weight		24.70+	2% of labeled weight

Table 2-9. **MAV's for an individual package labeled by volume - liquid or dry[a].**

Inch-Pound				Metric	
Labeled quantity	Liquid MAV (fl oz)	Labeled quantity	Dry MAV (cu in)	Labeled quantity	Liquid and dry MAV (mL)
up to and including 0.50 fl oz	b	up to and including 0.18 cu in	0.03	up to and including 3 mL	0.5[c]
		0.18+ to 0.49 cu in	0.06	3+ to 8 mL	1.0[c]
		0.49+ to 0.92 cu in	0.09	8+ to 15 mL	1.5[c]
0.50+[d] to[e] 0.75 fl oz	0.06	0.92+ to 1.35 cu in	0.11	15+ to 22 mL	2.0
0.75+ to 2.25 fl oz	0.13	1.35+ to 4.06 cu in	0.23	22+ to 67 mL	3.5
2.25+ to 4.25 fl oz	0.19	4.06+ to 7.67 cu in	0.34	67+ to 126 mL	5.5
4.25+ to 5.75 fl oz	0.25	7.67+ to 10.38 cu in	0.45	126+ to 170 mL	7.5
5.75+ to 7.50 fl oz	0.31	10.38+ to 13.54 cu in	0.56	170+ to 222 mL	9
7.50+ to 11.75 fl oz	0.38	13.54+ to 21.21 cu in	0.68	222+ to 347 mL	11
11.75+ to 17.00 fl oz	0.50	21.21+ to 30.68 cu in	0.90	347+ to 503 mL	15
17.00+ to 21.00 fl oz	0.63	30.68+ to 37.90 cu in	1.13	503+ to 621 mL	18
21.00+ to 27.00 fl oz	0.75	37.90+ to 48.73 cu in	1.35	621+ to 798 mL	22

Liquid Measure Equivalents
1 pint = 16 fl oz
1 quart = 32 fl oz
1 gallon = 128 fl oz

[a] Applies to shortages in package volume (that is, minus package errors).
[b] Convert to metric units and use laboratory glassware.
[c] Use laboratory glassware.
[d] 0.50+ means "greater than 0.50."
[e] "to" means "to and including."

Table 2-9 (continued). **MAV's for an individual package labeled by volume - liquid or dry.**

Inch-Pound				Metric	
Labeled quantity	Liquid MAV (fl oz)	Labeled quantity	Dry MAV (cu in)	Labeled quantity	Liquid and dry (MAV) (mL)
27.00+ to 31.00 fl oz	0.88	48.73+ to 55.95 cu in	1.58	798+ to 917 mL	26
31.00+ to 39.00 fl oz	1.00	55.95+ to 70.38 cu in	1.80	917+ mL to 1.153 L	30
39.00+ to 55.00 fl oz	1.25	70.38+ to 99.26 cu in	2.26	1.153+ to 1.627 L	37
55.00+ to 69.00 fl oz	2.50	99.26+ to 124.5 cu in	2.71	1.627+ to 2.041 L	44
69.00+ to 85.00 fl oz	1.75	124.5. to 153.4 cu in	3.2	2.041+ to 2.514 L	52
85.00+ to 103.00 fl oz	2.0	153.4+ to 185.9 cu in	3.6	2.514+ to 3.046 L	59
103.00+ to 160 fl oz (1.25 gal)	2.5	185.9+ to 288.8 cu in	4.5	3.046+ to 4.732 L	74
160+ to 185.6 fl oz	3.0	288.8+ to 335.0 cu in	5.4	4.732+ to 5.489 L	89
185.6+ to 240 fl oz	3.5	335.0+ to 433.1 cu in	6.3	5.489+ to 7.098 L	104
240+ to 272 fl oz	4.0	433.1+ to 490.9 cu in	7.2	7.098+ to 8.044 L	118
272+ to 344 fl oz	4.5	490.9+ to 620.8 cu in	8.1	8.044+ to 10.173	133
344+ to 392 fl oz	5.0	620.8+ to 707.4 cu in	9.0	10.173+ to 11.593	148
392+ to 560 fl oz	6.0	707.4+ to 1011 cu in	10.8	11.593+ to 16.561	177
560+ to 640 fl oz	7.0	1011+ to 1155 cu in	12.6	16.561+ to 18.927	207
640+ to 800 fl oz	8.0	1155+ to 1444 cu in	14.4	18.927+ to 23.659	237
800+ to 904 fl oz	9.0	1444+ to 1631 cu in	16.2	23.659+ to 26.734	266
Over 904 fl oz	1% of labeled volume	Over 1631 cu in	1% of labeled volume	Over 26.734 L	1% of labeled volume

See Section 2-13 for exception: bark mulch

Dry Measure Equivalent

1 Dry Pint = 33.6003125 cu in
1 Dry Quart = 67.200625 cu in
1 Bushel = 2150.42 cu in
1 cu ft = 1728 cu in

Table 2-10. MAV's for an individual package labeled by count[a].

Labeled count	MAV
up to and including 17[b]	0
18-50[b]	1
51-83	2
84-116	3
117-150	4
151-200	5
201-240	6
241-290	7
291-345	8
346-400	9
401-465	10
466-540	11
541-625	12
626-725	13
726-815	14
816-900	15
901-990	16
991-1075	17
1076-1165	18
1166-1250	19
1251-1333	20
1334 and over	1.5% of labeled count rounded off to the nearest whole number

[a] Applies only to shortages in package count (that is, minus package errors).

[b] See Section 5.2. for sampling plans to be used with these package sizes.

Table 2.11. MAV's for an individual package labeled by length (width) or by area[a]

Length		
Inch-Pound Labeled Length yards	MAV (expressed as a percentage of the labeled length)	Metric Labeled length meters
Up to and including 1	3%	Up to and including 1
1+[b] to[c] 48	1.5%	1+ to 40
48+ to 96	2%	40+ to 85
96+ to 154	2.5%	85+ to 140
154+ to 330	3%	140+ to 300
330+ to 1100	4%	300+ to 1000
1100+	5%	1000+
Area		
The MAV for packages labeled by area is 3% of the labeled area.		

[a] Applies only to shortages in package measure (that is, minus package errors).

[b] 1+ means greater than 1

[c] "to" means "to and including"

See Section 2.13. for exceptions: textiles, polyethylene sheeting.

Table 2-12. U.S. Department of Agriculture, Meat and Poultry, Groups and Lower Limits for individual packages*

Group Name	Definition of Group (numbers are labeled weight in ounces)		Lower Limit for Individual Weights
	Homogeneous, Fluid When Filled	All Other Products	
A	less than 3		10 % of labeled weight
1	3-16	-	7.1 g 0.25 oz 8/32 oz 4/16 oz 2/10 oz 2/8 oz 1/4 oz
2	over 16	3-7	14.2 g 0.50 oz 16/32 oz 8/16 oz 5/10 oz 4/8 oz 2/4 oz
3	-	over 7 to 48	28.3 g 1 oz
4	-	over 48 to 160	42.5 g 1.50 oz 1 16/32 oz 1 8/16 oz 1 5/10 oz 1 4/8 oz 1 2/4 oz
5	1	over 160	2 oz 1/4 lb

*See also Appendix J.

Table 3-1. Recommended maximum units of measure to be used in recording package weights.

Avoirdupois			Metric units	
Labeled weight	Units of measure (oz avoir)	Units of measure (lb)	Labeled weight	Units of measure (kg)
Up to and including 1.92 oz (0.12 lb)	a	a	Up to and including 82 g	a
Greater than 1.92 oz (0.12 lb) to and including 5.44 oz (0.34 lb)	1/32[b]	0.002[b]	Greater than 82 g to and including 250 g	0.001[b]
Greater than 5.44 oz (0.34 lb) to and including 20 oz (1.25 lb)	1/16	0.004	Greater than 250 g to and including 900 g	0.002
Greater than 1.25 lb to and including 4 lb	1/8	0.008	Greater than 900 g to and including 2.5 kg	0.005
Greater than 4 lb to and including 8 lb	1/4	0.02	Greater than 2.5 kg to and including 30 kg	0.01
Greater than 8 lb to and including 25 lb	1/2	0.03	Greater than 30 kg to and including 60 kg	0.05
Greater than 25 lb to and including 75 lb	1	0.05	Greater than 60 kg	0.1
Greater than 75 lb to and including 150 lb	2	0.01		
Greater than 150 lb	4	0.2		

[a] An analytical or other high accuracy balance will be necessary for weighing packages in this category.

[b] The equal-arm package scale must be used as null-indicator for packages labeled from 1.92 to 5.44 oz or 82 to 250 g to eliminate effects of possible tower errors.

Table 3-2. Test allowances for foam aerosol products

Avoirdupois: Labeled weight of package	Test allowance	
	Ounce	Pound
0 to less than 1 1/2 oz	0	0
1 1/2 oz to less than 5 oz	1/16	0.004
5 oz to less than 8 oz	1/8	0.008
8 oz to less than 11 oz	3/16	0.012
11 oz to less than 14 oz	1/4	0.016
14 oz to less than 1 lb 1 oz	5/16	0.020
1 lb 1 oz or more	3/8	0.023

Metric: Labeled weight of package	Test allowance
	Grams
0 to less than 50 g	0
50 g to less than 100 g	1
100 g to less than 200 g	3
200 g to less than 300 g	5
300 g to less than 400 g	7
400 g to less than 500 g	9
Over 500 g	10

Table 4-1. Weighing devices appropriate to use to check common consumer products labeled by liquid volume.

Labeled volume (inch-pound)	Device	Labeled volume (metric)
Up to and including 4.25 fl oz	analytical or other high accuracy balance	Up to and including 126 mL
Greater than 4.25 fl oz to and including 32 fl oz	small capacity equal-arm scale or equivalent	Greater than 126 mL to and including 1 L
Greater than 32 fl oz to and including 3 gal	large capacity equal-arm scale or equivalent	Greater than 1 L to and including 12 L
Greater than 3 gal	commercial scale and substitution weighing	Greater than 12 L

Table 4-2. Recommended maximum units of measure to be used for recording the weights of packaged goods labeled by liquid volume.

Inch-Pound			Metric	
Labeled volume	Units of measure		Labeled volume	Units of measure (g)
	(oz avoir)	(lb)		
Up to and including 4.25 fl oz	a	a	Up to and including 3 mL	0.01[a]
			Greater than 3 mL to and including 126 mL	0.1[a]
Greater than 4.25 fl oz to and including 17.00 fl oz	1/32[b]	0.002[b]	Greater than 126 mL to and including 503 mL	1.0[b]
Greater than 17.00 fl oz to and including 55.00 fl oz	1/16	0.004	Greater than 503 mL to and including 2.041 L	2.0
Greater than 55.00 fl oz to and including 1.25 gal	1/8	0.01	Greater than 2.041 L to and including 5.489 L	5.0
Greater than 1.25 gal to and including 1.875 gal	1/4	0.02	Greater than 5.489 L to and including 37.5 L	10.0
Greater than 1.875 gal to and including 4.375 gal	1/2	0.03		
Greater than 4.375 gal to and including 9 gal	1	0.05		
Greater than 9 gal to and including 18 gal	2	0.1		

[a] Use analytical or other high accuracy balance.

[b] Use package checking scale as null indicator.

Table 4-3. Maximum permitted difference in weights of two equal quantities according to the type of scale used to weigh.

Type of Scale	Pounds	Grams
Analytical or other high accuracy balance	0.0001	0.05
Small capacity equal-arm scale or equivalent	0.002	1.0
Large capacity equal-arm scale or equivalent	0.004	2.0
Commercial scale up to and including 30 lb (14 kg)	0.01	5.0
Commercial scale above 30 lb (14 kg) up to and including 100 lb	0.02	9.0

Table 4-4. Thickness of paint can walls and labels.

Wall thickness			
Inch-pound		Metric	
can size	in	can size	mm
1 gal	0.010	4 L	0.25
1/2 gal	0.010	2 L	0.25
1 qt	0.009	1 L	0.23
1 pt	0.008	500 mL	0.23
		250 mL	0.20

Label thickness (paper)[a] (all can sizes)	
Inch-pound	Metric
0.004 in	0.10 mm

[a] The thickness of labels lithographed directly onto the container may be ignored.

Table 5-1. Sampling plans for packages labeled by low count[a]

1	2	3	4
Lot size (number of packages in lot) N	Sample size (number of packages in sample) n	Tare sample size (number of packages chosen for tare determination) n_t	Number of packages allowed to contain fewer than the labeled count.
Up to and including 500	10	2	1
501-5000	30	2	2
5001 and greater	50	5	3

[a] Labeled count is 50 or fewer units.

Table 5-2. Sampling plans for packages given tolerances.

1	2	3	4
Lot size N	Sample size n	Tare sample size n_t	Number of package errors which may exceed allowable difference
Up to and including 500	10	2	0
501-5,000	30	2	1
5,0001 and over	50	5	2

APPENDIX C. GLOSSARY

ACCEPTANCE TOLERANCE.[1] The limit of inaccuracy for new, newly reconditioned, or adjusted equipment. (See Section 3.1.)

ALLOWABLE DIFFERENCE. The amount by which the actual quantity in the package may differ from the declared quantity. Pressed and blown tumblers and stemware labeled by count and capacity are assigned an allowable difference in capacity. (See Section 5.7.)
Also termed Tolerance.

ANALOGUE SCALE. A weighing device in which weight values are indicated by means of "a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device."[1] (See Section 3.9.)

AUDIT TESTING. Preliminary tests designed to quickly identify potential noncompliance. (See Section 1.5.)

AVERAGE. The sum of a number of individual measurement values divided by the number of values. For example, the sum of the individual weights of 12 packages divided by 12 would be the average weight of those packages.

AVERAGE ERROR. The sum of the individual package errors (defined) (considering their arithmetic sign) divided by the number of packages comprising the sample. (See Section 2.6.2.)

AVERAGE REQUIREMENT. (See Section 1.2.1.)

AVERAGE TARE. The sum of the weights of individual package containers (or wrappers, etc.) divided by the number of containers or wrappers weighed.

AVOIRDUPOIS UNITS. The inch-pound unit (defined) for weight commonly used in the United States of America, based on the pound of 16 ounces and the ounce of 16 drams.

BERRY BASKETS AND BOXES.[1] Disposable containers in capacities of 1 dry quart or less for berries and small fruits.

BREAK POINT. That point at which a digital indicator changes its indication from one value to an adjacent value. (This is determined by adding test weights 0.1 of the value of the smallest indication until the break point is reached.) (See Section 3.9.)

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[1] NBS Handbook 44.

CATEGORY A (CATEGORY B). A set of sampling plans provided in this handbook for use in checking packages that must meet the average requirement (defined). (See Section 2.6. for Category A, and Section 2.7. for Category B.)

CHECKWEIGHER. A weighing device often used in packaging operations. It separates packages into weight groups according to the amount their actual weights differ (over or under) from the target or nominal weight.

COMBINATION QUANTITY DECLARATIONS.[1] A package label that contains the count of items in the package as well as one or more of the following: weight, measure, or size.

COMPLIANCE TESTING. The determination of conformance of packages with specified legal requirements.

CORRECTED AVERAGE TARE. For foam product aerosols (defined), this is the average tare (defined) as measured minus the test allowance (defined). (See Section 3.11.6. and Table 3-2.)

DECISION CRITERIA. The rules for deciding whether or not a lot is in conformance with package requirements based on the results of checking the packages in the sample. (See Sections 2.6.1., 2.6.2., 2.7.1., and 2.7.2.)

DELIVERY. A quantity of identically labeled product received at one time by a buyer.

DIMENSIONLESS UNITS. The integers in terms of which the official records package errors. The dimensionless units must be multiplied by the unit of measure (defined) to obtain package errors in terms of weight, length, etc. (See Section 2.9.1.)

DISPOSABLE CONTAINERS. A package container designed to be used only once.

DIVISION[2] (on a scale). For a mechanical scale: the smallest subdivision of the scale. For a digital (electronic) scale: the difference between two consecutively indicated values.

DRAINED WEIGHT. The weight of solid or semisolid product representing the contents of a package obtained after a prescribed method for removal of the liquid has been employed. (See Section 3.10 and 3.13.)

DRY MEASURE.[2] Rigid containers designed for general and repeated use in the volume measurement of particulate solids.

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[1] NBS Handbook 130, Uniform Method of Sale of Commodities Regulation.

[2] NBS Handbook 44.

DRY TARE. All packaging materials (including glue, labels, ties, etc.) that will contain or enclose the product, but before the product is introduced into the container. Prizes, gifts, coupons, or decorations that are not part of the product are defined as part of the tare also. (See Section 2.11.)

ERROR. See PACKAGE ERROR.

FILL WEIGHT. A supplemental statement of the weight of solids put into the package (usually canned food) but before further processing. It is not the same as a drained weight statement.

FOAM PRODUCT AEROSOL. A product that forms a foam at the container valve or on impingement with a surface, the foam volume not being substantially reduced for at least 20 seconds.

FLUSH FILL CAPACITY. The capacity of a cup or container as defined by the volume contained by it when a flat plate (such as a slicker plate (defined)) rests on its rim.

GROSS WEIGHT. The weight of the package including contents, packing material, labels, etc.

HEADSPACE. The container volume not occupied by product.

INDEX OF AN INDICATOR. That particular portion of an indicator (as, for example, on a weighing scale) that is directly utilized in making a reading (e.g., the tip of a movable pointer on a dial) (See Section 3.4.)

INCH-POUND UNITS. Units based upon the yard, gallon, and the pound commonly used in the United States of America. Some of these units have the same name as similar units in the United Kingdom (British, English, or UK units), but are not necessarily equal to them.

INITIAL TARE SAMPLE. The first packages (either two or five) selected from the sample to be opened for tare determination in the alternative tare procedure. Depending upon the variability of these individual tare weights as compared with the variability of the net contents, this initial tare sample may be sufficient or more packages may be needed to determine the tare. (See Section 2.11.4. and Table 2-6.)

INSPECTION LOT. The collection of identically labeled (except for actual quantity in the case of random pack) packages available for inspection at one time. This collection will pass or fail as a whole based on the results of tests on a sample drawn from this collection. (See Section 2.3.)

LABEL.[1] "Any written, printed, or graphic matter affixed to, applied to, attached to, blown into, formed, molded into, embossed on, or appearing upon or adjacent to a consumer commodity or a package containing any consumer commodity, for purposes of branding, identifying, or giving any information with respect to the commodity or to the contents of the package, except that an inspector's tag or other nonpromotional matter affixed to or appearing upon a consumer commodity...(is)...not...a label."

LOCATION OF TEST. The place where the package will be examined. Broadly defined as one of three general locations: (1) where the commodity was packaged, (2) a warehouse or storage location; or (3) a retail outlet.

LOT. See INSPECTION LOT.

LOT CODE. A series of identifying numbers and/or letters on the outside of a package designed to provide information such as the date and location of packaging, the expiration date, and so on.

LOT SIZE. The number of packages in the inspection lot (defined). See Section 2.3.3.

LUBRICATING OIL BOTTLES.[2] A rigid (inflexible) measure container (defined) for repeated use in "measurement of lubricating oil for direct delivery to the crankcase of a motor vehicle, whether or not the bottle is sealed with a cap or some other device."

MAV (MAXIMUM ALLOWABLE VARIATION). A deficiency in the weight, measure or count of an individual package beyond which the deficiency is considered to be an unreasonable error (defined). The number of packages with deficiencies greater than the MAV is controlled by the sampling procedure. (See Section 2.12.)

MEAN OR ARITHMETIC MEAN. See AVERAGE.

MEASURE CONTAINERS.[2] Containers whose capacities are used to determine quantity. They are of two basic types: (a) retail and (b) prepackaged. Retail containers are packaged at the time of retail sale and prepackaged containers are packaged in advance of sale. An example of a prepackaged measure container is an ice cream package.

METERED VALVE. A push-button operated aerosol delivery device that meters a pre-determined quantity of product when depressed and then shuts off automatically. No additional product will be expelled until the push button is released and depressed again to repeat the procedure.

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[1] NBS Handbook 130, Uniform Packaging and Labeling Regulation.

[2] NBS Handbook 44.

MILK BOTTLES.[1] A container that is designed as a measure container (defined) for repeated use in the measurement and delivery of milk and other fluid dairy products at retail.

MINUS OR PLUS ERRORS. Negative or positive deviations from the labeled quantity of the actual package quantities as measured. (See PACKAGE ERRORS.)

MOISTURE ALLOWANCE. That variation in weight of a packaged product permitted in order to account for loss of weight due to loss of moisture during good package-distribution practices. (See Sections 1.9., 2.14., Step 4 of Section 3.5.)

NET QUANTITY OR NET CONTENTS. That quantity of packaged product remaining after all necessary deductions for tare (defined) have been made.

NOMINAL.[1] "Refers to 'intended' ... as opposed to 'actual'."

NOMINAL GROSS WEIGHT. The sum of the nominal tare weight (defined) plus the declared or labeled weight (or other labeled quantity converted to a weight basis). (See Section 2.11. and step 5 of Section 3.5.)

NOMINAL TARE WEIGHT. The quantity designated as tare (defined) and used in the determination of the nominal gross weight. It may be an average tare value or a corrected average tare value.

NULL INDICATOR. A device or portion of device used to indicate a "zero" or load-balanced condition.

OBSERVED VALUE. A particular quantity determined as the result of an observation, test, or measurement.

PACKAGED GOODS.[2] "Product or commodity put up in any manner in advance of sale suitable for either wholesale or retail sale."

PACKAGE ERROR. The difference between the actual net contents of an individual package as measured and the declared net contents on the package label; (-) minus for less than the label and (+) plus for more than the label. (See Section 2.9.)

POISE.[1] "A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values."

PLUS ERRORS. See MINUS OR PLUS ERRORS.

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[1] NBS Handbook 44.

[2] 16 CFR §500.2(h).

PRINCIPAL DISPLAY PANEL.[1] "The term 'principal display panel or panels' shall be construed to mean that part, or those parts, of a label that is, or are, so designed as to most likely be displayed, presented, shown, or examined under normal and customary conditions of display and purchase. Wherever a principal display panel appears more than once on a package, all requirements pertaining to the 'principal display panel' shall pertain to all such 'principal display panels'."

PRODUCTION LOT. The total collection of packages defined by the packager, usually consisting of those packages produced within a given unit of time and coded identically.

PYCNOMETER. A container of known volume used to contain material for weighing so that the weight of a known volume may be determined for the material. (See Section 4.10.)

RANDOM PACK.[2] "The term 'random package' shall be construed to mean a package that is one of a lot, shipment, or delivery of packages of the same consumer commodity with varying weights; that is, packages of the same consumer commodity with no fixed pattern of weight."

RANDOM SAMPLING. The process of selecting sample packages such that all packages under consideration have the same probability of being selected. An acceptable method of random selection is to use a table of random numbers. (See Appendices E, F and G.)

RANGE. The difference between the largest and the smallest of a set of measured values. (See Appendix H.)

REASONABLE VARIATION. An amount by which individual package net contents are allowed to vary from the labeled net contents. This term is found in most Federal and State laws and regulations governing packaged goods. (See Appendix D.) This handbook defines the limits of reasonable variation only in terms of negative deviations from the label, referred to as "MAV" (defined).

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[1] NBS Handbook 130, Uniform Packaging and Labeling Regulation.

[2] NBS Handbook 130, Uniform Packaging and Labeling Regulation.

ROUNDING. The process of omitting some of the end digits of a numerical value and adjusting the last retained digit so that the resulting number is as near as possible to the original number. (See Section 3.4.)

SAMPLE. A group of packages taken from a larger collection of packages and providing information that can be used as a basis for making a decision concerning the larger collection of packages or of the package production process. A sample provides a valid basis for decision only when it is a random sample (defined). (See Appendix E.)

SAMPLE SIZE. The number of packages in a sample.

SAMPLING PLAN. A specific plan that states the number of packages to be checked and the associated decision criteria. (See Section 1.4.)

SCALE TOLERANCE. The official value fixing the limit of allowable error for commerical weighing equipment as defined in NBS Handbook 44.

SEAT (as in "seat diameter" or "seated capacity"). The projection or shoulder near the upper rim of a cup or container that is designed to serve as the support for a lid or cover.

SEATED CAPACITY. The capacity of a cup, container, or bottle, as defined by the volume contained by them when the lid or a flat disc is inserted in the lid groove located inside and near the upper rim of the cup, container, or bottle. (See Section 4.14.)

SENSITIVITY[1] (of a weighing device). The minimum change in the position of rest of the indicating element of the scale in response to an increase or decrease of the test-weight load on the scale. (See Section 3.1.)

SHIPMENT. A quantity of identically labeled product (except for lot code) sent at one time to a single location.

SLICKER PLATE. A flat plate, usually of glass or clear plastic composition used to determine the "level full" condition of a capacity (volumetric) measure. (See Section 4.10. and 4.14.)

STANDARD DEVIATION. A measure to describe the scatter of the individual package contents around the mean contents. (See Section 2.6.2.)

STANDARD PACK. That type of package in which a commodity is put up with identical labels and only in certain specific quantity sizes. Examples of goods so packed are canned, boxed, bottled and bagged foods, and over-the-counter drugs.

SUBSTITUTION WEIGHING. The use of a commercial scale as a "null indicator" (defined). The weight of the package or product is determined by using the official's test weights (defined), the commercial scale serving merely as an indicator for a "zero" or load balanced condition and not as an indicating device. (See Section 3.9.)

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[1] NBS Handbook 44.

SUPPLEMENTARY QUANTITY DECLARATIONS.[1] "The required quantity declaration may be supplemented by one or more declarations of weight, measure, or count, such declaration appearing other than on a principal display panel. Such supplemental statement of quantity of contents shall not include any terms qualifying a unit of weight, measure, or count that tends to exaggerate the amount of commodity contained in the package (e.g., 'giant' quart, 'full' gallon, 'when packed,' 'minimum,' or words of similar import)."

SURVEY TESTING. See audit testing.

TAPE RULES.[2] Flexible steel linear measures.

TARE WEIGHT. The weight of a container, wrapper, or other material (see discussion in Section 2.11.) that is deducted from the gross weight to obtain the net weight.

TARE SAMPLE. The packages or packaging material used to determine the average tare weight. (See Section 2.11.)

TARE SAMPLE SIZE. The number of packages or packaging material units used to determine the average tare weight. (See column 3 of Tables 2-2 or 2-5.)

TEST ALLOWANCE. An allowance made to compensate for differences in delivery of foam aerosol packaged products between normal consumer usage and the test procedure. (See Section 3.11.6.)

TEST WEIGHTS. Weights of known value used to check the accuracy of package quantities and scales (also used in substitution weighing). (See Section 3.1.)

TOLERANCE. A value fixing the limit of allowed departure from the labeled contents; usually presented as a (+) and a (-) value. (See Sections 1.2.2. and 5.7.)

UNIT OF MEASURE. An increment of weight, length, or volume chosen so that an inspector may record package errors in terms of small integers. (The package errors are actually the integers multiplied by the unit of measure.) (See Section 2.9.1.)

UNREASONABLE ERRORS. Minus package errors that exceed the MAV (defined). (See step 7 of Section 3.5.) The number of unreasonable errors permitted in a sample is specified by the sampling plan.

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[1] 16 CFR §500.20.

[2] NBS Handbook 44.

VALVE ACTUATOR (VALVE BUTTON). The push button located on the top of the aerosol package that controls the flow of product by means of a valve.

VAPOR TAP VALVE. A push button aerosol delivery device that will expel product whether the container is in the upright or inverted position.

VOLUMETRIC MEASURES. Standard measuring flasks, graduates, cylinders, etc. for use in the measurement of volumes of liquids. (See Section 4.2.)

WET TARE. All packaging materials that can be separated from the packaged product after packaging. Washing, scraping, ambient air drying, and other techniques involving more than "normal" household recovery procedures may be used but laboratory procedures such as oven drying the packaging material are not used. As in the dry tare definition, prizes, decorations, and such are also part of the wet tare. (See Section 2.11.)

APPENDIX D. PACKAGE NET CONTENTS REGULATIONS

Certain portions of the Federal and State regulations that refer specifically to labeled net contents on packages are listed below. Additional information concerning packaging and labeling and appropriate methods of sale are contained in NBS Handbook 130.

D.1. FEDERAL REGULATIONS

References are taken from the April, 1983, Code of Federal Regulations.

D.1.1. U.S. Department of Health and Human Services, Food and Drug Administration

Food
21 CFR §101.105

(q) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Food, aerosols
21 CFR §101.105

(g) The declaration shall accurately reveal the quantity of food in the package exclusive of wrappers and other material packed therewith: Provided, That in the case of foods packed in containers designed to deliver the food under pressure, the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed. The propellant is included in the net quantity declaration.

Prescription drugs
21 CFR §201.51

(g) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large. In the case of a liquid drug in ampules or vials, intended for injection, the declaration shall be considered to express the minimum quantity and the variation above the stated measure shall comply with the excess volume prescribed by the National Formulary or the U.S. Pharmacopeia for filling of ampules. In the case of solid drug in ampules or vials, the declaration shall be considered to express the accurate net weight. Variations shall comply with the limitations provided in the U.S. Pharmacopeia or the National Formulary.

Over-the-counter drugs, aerosols
21 CFR §201.62

(f) The declaration shall accurately reveal the quantity of drug or device in the package exclusive of wrappers and other material packed therewith: Provided, That in the case of drugs packed in containers designed to deliver the drug under pressure, the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed. The propellant is included in the net quantity declaration.

Over-the-counter drugs
21 CFR §201.62

(q) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Cosmetics, aerosols
21 CFR §701.13

(g)(1) In the case of cosmetics packed in containers designed to deliver the cosmetic under pressure, the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed. The propellant is included in the net quantity declaration.

Cosmetics
21 CFR §701.13

(s) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Medical devices
21 CFR §801.62

(q) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

D.1.2. U.S. Department of Agriculture, Food Safety and Quality Service

Meat
9 CFR §317.2

(h)(2) The statement as it is shown on a label shall not be false or misleading and shall express an accurate statement of the quantity of contents of the container exclusive of wrappers and packing substances. Reasonable variations caused (1) by loss or gain of moisture during the course of good distribution practices or (2) by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Poultry
9 CFR §381.121

(c)(6) The statement as it is shown on a label shall not be false or misleading and shall express an accurate statement of the quantity of contents of the container, exclusive of wrappers and packaging substances. Reasonable variations caused by loss or gain of moisture during the course of distribution, notwithstanding good distribution practices or by unavoidable deviations, notwithstanding good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large. The statement shall not include any term qualifying a unit of weight, measure or count such as "jumbo quart," "full gallon," "giant quart," "when packed," "minimum" or words of similar import, except as provided in paragraph (b) of this section.

D.1.3. Federal Trade Commission

Non-food consumer commodities covered under the Fair Packaging and Labeling Act, 16 CFR §500.22.

(a) The statement of net quantity of contents shall accurately reveal the quantity of the commodity in the container exclusive of wrappers and other material packed therewith: Provided, That in the case of a commodity packed in a container designed to deliver the commodity under pressure, the statement shall declare the net quantity of the contents that will be expelled when the instructions for use are followed. The propellant is included in that net quantity statement.

(b) Variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure, after the commodity is introduced into interstate commerce, to conditions which normally occur in good distribution practice and which unavoidably result in change of weight or measure.

(c) Variations from the stated weight, measure or numerical count shall be permitted when caused by unavoidable deviations in weighing, measuring, or counting the contents of individual packages which occur in good packaging practice: Provided, that such variations shall not be permitted to such extent that the average of the quantities in the packages comprising a shipment or other delivery of the commodity is below the quantity stated, and no unreasonable shortage in any package will be permitted, even though overages in other packages in the same shipment or delivery compensate for such shortage. Variations from stated quantity of contents shall not be unreasonably large.

D.1.4. Environmental Protection Agency

Pesticides (including aerosols)
40 CFR §162.10

(d) Net weight or measure of contents.

(1) The net weight or measure of content shall be exclusive of wrappers or other materials and shall be the average content unless explicitly stated as a minimum quantity.

(2) If the pesticide is a liquid, the net content statement shall be in terms of liquid measure at 68 °F (20 °C) and shall be expressed in conventional American units of fluid ounces, pints, quarts, and gallons.

(3) If the pesticide is solid or semisolid, viscous or pressurized, or is a mixture of liquid and solid, the net content statement shall be in terms of weight expressed as avoirdupois pounds and ounces.

(4) In all cases, net content shall be stated in terms of the largest suitable units, i.e., "1 pound 10 ounces" rather than "26 ounces."

(5) In addition to the required units specified, net content may be expressed in metric units.

(6) Variation above minimum content or around an average is permissable only to the extent that it represents deviation unavoidable in good manufacturing practice. Variation below a stated minimum is not permitted. In no case shall the average content of the packages in a shipment fall below the stated average content.

D.1.5. U.S. Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms

Wine
27 CFR §4.37

(e) Tolerances. Statement of net contents shall indicate exactly the volume of wine within the container, except that the following tolerances shall be allowed:

(1) Discrepancies due exclusively to errors in measuring which occur in filling conducted in compliance with good commercial practice.

(2) Discrepancies due exclusively to differences in the capacity of containers, resulting solely from unavoidable difficulties in manufacturing such containers so as to be of uniform capacity: Provided, That no greater tolerance shall be allowed in case of containers which, because of their design, cannot be made of approximately uniform capacity than is allowed in case of containers which can be manufactured so as to be of approximately uniform capacity.

(3) Discrepancies in measure due to differences in atmospheric conditions in various places and which unavoidably result from the ordinary and customary exposure of alcoholic beverages in containers to evaporation. The reasonableness to discrepancies under this paragraph shall be determined on the facts in each case.

(f) Unreasonable shortages. Unreasonable shortages in certain of the containers in any shipment shall not be compensated by overages in other containers in the same shipment.

27 CFR § 240.578

Proprietors of bonded wine cellars will be held strictly responsible for the correct determination of the quantity and alcohol content of wine removed. As required by §240.173, appropriate and accurate measures and instruments for measuring and testing the wine must be provided at each wine cellar. Bottles must be filled as nearly as possible to conform to the amount shown on the label or blown in the bottle to be contained therein, but in no event may the amount of wine contained in any bottle, due to lack of uniformity of the bottles, vary more than two percent from the amount stated to be contained therein; and further in such case there shall be substantially as many bottled overfilled as there are bottles underfilled for each lot of wine bottled

Distilled spirits
27 CFR §5.47 and 27 CFR §5.47a

(b) Tolerances. The following tolerances shall be allowed:

(1) Discrepancies due to errors in measuring which occur in filling conducted in compliance with good commercial practice.

(2) Discrepancies due to differences in the capacity of bottles, resulting solely from unavoidable difficulties in manufacturing such bottles to a uniform capacity: Provided, That no greater tolerance shall be allowed in case of bottles which, because of their design, cannot be made of approximately uniform capacity than is allowed in case of bottles which can be manufactured so as to be of approximately uniform capacity.

(3) Discrepancies in measure due to differences in atmospheric conditions in various places and which unavoidably result from the ordinary and customary exposure of alcoholic beverages in bottles to evaporation. The reasonableness of discrepancies under this paragraph shall be determined on the facts in each case.

27 CFR §19.397

(b) Variations in proof and fill. If the contents do not agree with the respective data on the label or bottle as to -

(1) Quantity (fill), except for such variations in measuring as may occur in filling conducted in compliance with good commercial practice with the overall objective of maintaining 100 percent fill for all bottled products; and/or

> (2) Proof, subject to a normal drop in proof occurring during bottling operations not to exceed three-tenths of a degree the proprietor shall rebottle, recondition, or label the spirits in such manner that the label will correctly describe the contents.

Beer
21 CFR §245.126 (in part)

> The statement of net contents shall indicate exactly the volume of beer within the bottle except for such variations in measuring as may occur in filling conducted in compliance with good commercial practice. Short-fill bottles of beer which are sold or otherwise disposed of by a brewery to its own employees for their own use but which are not for resale need not be labeled, but, if labeled, need not show an accurate statement of net contents

D.2. REGULATIONS RECOMMENDED BY THE NCWM FOR STATE ADOPTION

The National Conference on Weights and Meaures (NCWM), an organization of State and local weights and measures officials, has adopted guidelines and standards upon which individual States and other jurisdictions may model their laws and regulations. A majority of the States have adopted the following portion of the NCWM Uniform Packaging and Labeling Requirements[1] quoted below.

SECTION 6. DECLARATION OF QUANTITY: CONSUMER PACKAGES

> 6.13. CHARACTER OF DECLARATION: AVERAGE. —The average quantity of contents in the package of a particular lot, shipment, or delivery shall at least equal the declared quantity, and no unreasonable shortage in any package shall be permittaed, even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage.

SECTION 7. DECLARATION OF QUANTITY: NONCONSUMER PACKAGES

> 7.6. CHARACTER OF DECLARATION: AVERAGE. — The average quantity of contents in the package of a particular lot, shipment, or delivery shall at least equal the declared quantity, and no unreasonable shortage in any package shall be permitted, even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage.

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[1] NBS Handbook 130.

SECTION 12. VARIATIONS TO BE ALLOWED.

12.1. PACKAGING VARIATIONS.

12.1.1. VARIATIONS FROM DECLARED NET QUANTITY. — Variations from the declared net weight, measure, or count shall be permitted when caused by unavoidable deviations in weighing, measuring, or counting the contents of individual packages that occur in good packaging practice, but such variations shall not be permitted to such extent that the average of the quantities in the packages of a particular commodity, or a lot of the commodity that is kept, offered, or exposed for sale, or sold, is below the quantity stated, and no unreasonable shortage in any package shall be permitted, even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage. Variations above the declared quantity shall not be unreasonably large.

12.1.2. VARIATIONS RESULTING FROM EXPOSURE. --Variations from the declared weight or measure shall be permitted when caused by ordinary and customary exposure to conditions that normally occur in good distribution practice and that unavoidably result in change of weight or measure, but only after the commodity is introduced into intrastate commerce: Provided, that the phrase "introduced into intrastate commerce" as used in this paragraph shall be construed to define the time and the place at which the first sale and delivery of a package is made within the state, the delivery being either

(a) directly to the purchaser to his agent, or

(b) to a common carrier for shipment to the purchaser, and this paragraph shall be construed as requiring that, so long as a shipment, delivery, or lot of packages of a particular commodity remains in the possession or under the control of the packager or the person who introduces the package into intrastate commerce, exposure variations shall not be permitted.

APPENDIX E. SELECTION OF A RANDOM SAMPLE

E.1. INTRODUCTION

All of the sampling plans presented in this handbook are based on the assumption that the packages constituting the sample are chosen at random from the inspection lot. Randomness in this instance means that every package in the lot has an equal chance of being selected as part of the sample. It does not matter what other packages have already been chosen, what the package net contents are, or where the package is located in the lot.

The selection of a random sample requires some care. The procedures that follow present several methods for obtaining a random sample, and a randomly selected subsample for tare. However they are not the only techniques that may be used. (See Section E.5.)

For the discussion that follows, there are considered to be N packages in the inspection lot and n packages in the sample.

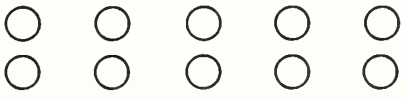
To obtain a random sample, two steps are necessary. First it is necessary to identify each package in the lot of N packages with a specific number whether on the shelf, in the warehouse or coming off the packaging line. Then it is necessary to obtain n random numbers, as from a table of random numbers for example. These n random numbers indicate exactly which packages in the lot shall be taken for the sample.

E.2. LOT NUMBERING SYSTEMS

A numbering system or scheme for the lot must be decided upon before selecting the random numbers for the sample. There are many methods of numbering the lot, two of which are outlined below.

E.2.1. Serial Lot Numbering Systems

In a simple arrangement, such as packages on a shelf or on a packing line, the packages in the lot can be considered to be numbered from 1 to N. The testing official does not have to mark the packages with numbers, but may imagine each package as having a number associated with it. The official may straighten the packages on the shelf before beginning if that helps to clarify the envisioned numbering system. A simple sketch on a piece of cross-section paper may also be helpful. For example, if the packages are in only one layer, the packages could be found (or arranged) in rows and columns on the shelf, as shown (standing in front of and looking down at the shelf):



Imagine that the packages are numbered from 1 to 10 in some systematic fashion, perhaps:

⑥ ⑦ ⑧ ⑨ ⑩
① ② ③ ④ ⑤

If there is more than one layer of packages, the serial numbering system can be extended, layer by layer. In the example above, the second layer would be considered to be packages numbered 11 through 20, the third layer, packages numbered 21 through 30, etc.; in the same pattern as given for the first 10.

The inspector can use any numbering scheme provided that each package has a number associated with it, and can be located by its number. In the 3-layer scheme suggested above, with N = 30, package number 26 would be in the third layer, second row from the front, first package on the left.

E.2.2. Three-Dimensional Numbering System

If a large stack of packages must be numbered, it may be more convenient to use a three-dimensional lot numbering system with a designated "zero point" (starting place), say the lower left corner of the stack. The official can then use three directions to count from this starting place--to the Right, Up, and toward the Back (RUB). If, from the zero point, there are 10 units to the Right, 3 units Up, and 7 units Back, the dimensions of the stack are 10.by 3 by 7. As an example, unit number 4-1-5, would be the package located 4 units to the Right of the zero point, 1 unit Up, and 5 units towards the Back. (See Figure E-1).

E.3. THE RANDOM NUMBER TABLE

E.3.1. General

A random number table such as in Appendix G is composed of the digits from 0 through 9, with approximately equal frequency of occurrence. The table consists of 31 pages. On each page digits are printed in blocks of five columns and blocks of five rows. The printing of the table in blocks is intended only to make it easier to locate specific columns and rows.

E.3.2. Random Starting Place.

a. Starting Page. - The pages of Appendix G are numbered G-1 through G-31. Use the day of the month to determine the starting page. For example, if the inspection takes place on February 11, use page G-11 as the first page (then pages G-12 through G-31, followed by pages G-1 through G-10 if necessary).

b. Starting Column and Row. - Use the auxiliary table, Appendix F, to get the starting column and row. (Alternatively, the inspector may choose a starting page in the random number table and with eyes closed, drop a pencil anywhere on the page to indicate a starting place in the table.) Appendix F consists of two pages. On each page there are 600 pairs of numbers in parentheses. The first number of a pair indicates the starting column in Appendix G, and the second number the starting row. The first pair at the upper left hand corner of the first page may be used the first time. After a pair is used, it may be crossed out and another pair used the next time, proceeding systematically either across or down the page.

For example, assume that testing takes place on the 11th day of the month. Start with page G-11 of the random number table in Appendix G. Use the auxiliary table in Appendix F to select the starting place. If the auxiliary table is being used for the first time, use the first pair of numbers (22, 45). Start using the random number table of Appendix G, on page G-11, column 22, row 45. That number is 3.

If 1-digit random numbers are needed, record them, going down the column to the bottom of the page and then to the top of the next column, and so on. Ignore duplicates and record zero (0) as ten (10). Following on from the last example, these numbers are 3, 5, 7, 10, 4, etc. If two-digit random numbers are needed, rule off the page, and further pages if necessary, in columns of two digits each. If there is a single column left on the page, ignore this column, and rule the next page in columns of two. Again, ignore duplicate numbers and record 00 as 100. For example, using the same starting place as in the last example, (page G-11, column 22, row 45) the recorded two-digit recorded numbers would be 31, 58, 72, 2, 46, 71, 43, etc. When three-digit numbers are needed, rule the page in columns of three. Record 000 as 1000. Starting on page G-11, column 22, row 45, the recorded numbers would be 316, 585, 722, 24, 461, 715, 376, 244, 921, 289, etc.

E.4. OBTAINING RANDOM NUMBERS FOR THE SAMPLE

E.4.1. Serial Lot Numbering System

Once the packages in the lot have been assigned numbers (from 1 to N), it is necessary to obtain n random numbers that will correspond to those packages that will become the random sample. If the lot contains 100 packages or fewer, use two-digit random numbers. If the lot consists of more than 100, but not more than 1000 packages, use three-digit random numbers. Using the random number table (Appendix G), rule the table off in columns (if desired). Read off successive numbers less than or equal to N until n different numbers have been recorded on a worksheet. These designate the packages for the test sample.

The testing official may, of course, rearrange these random numbers in a serial fashion to facilitate actual package selection (or mark through the random numbers on the worksheet as packages are selected). In any event, the order in which the numbers come out of the random number table indicates those packages in the sample to be chosen as the tare.

For example: The lot consists of 99 packages. A sample of 10 packages is required. Starting on page G-11, column 22, row 45, the following random numbers are recorded: 31, 58, 72, 2, 46, 71, 43, 82, 79, 40. (If a duplicate appears in the table, it is ignored—e.g., 72 appears twice.) If 00 had appeared, it would have been ignored in this case (it would usually be recorded as 100). The packages corresponding to the 10 random numbers are selected for the sample.

Package Selection Worksheet
for a Serial Lot Numbering System

Sample package in the sequence to be used for tare determination	Package number in lot (in the order they are selected from the random number table)	Rearranged in the in the order to be to be selected from the lot
1	31	2
2	58	31 tare
3	72	40
4	2	43
5	45	46
6	71	58 tare
7	43	71
8	82	72
9	79	79
10	40	82

Figure E-1.

Note that the tare sample is obtained according to the order in which the random numbers are recorded; that is, for a sample of 10, the tare sample in this instance, would be packages numbered 31 and 58 in the lot.

E.4.2. Three-Dimensional Lot Numbering System

The official should choose a convenient "zero point" (such as the lower left corner of the stack) and record the number of packages in the stack in each of the three directions (RUB). For example, the stack might be 10 by 7 by 3, i.e., 10 units to the Right of the starting place, 7 units Up, and 3 units Back.

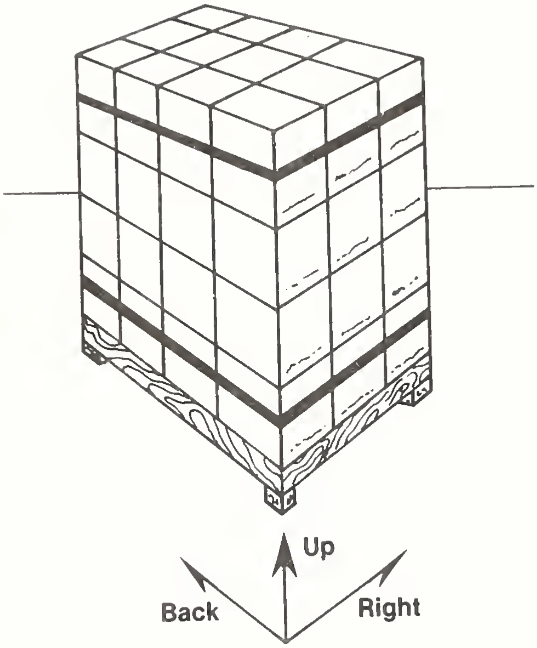


Figure E-2. Choosing a starting place for a three-dimensional lot numbering system.

A work table like that in Figure E-3 is useful to record the positions of sample packages in the lot as determined from the random number table.

Package Selection Worksheet for a Three-Dimensional Lot Numbering System			
Sample package in the sequence to be used for tare determination	Package location		
	Right	Up	Back
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
(continue if larger sample size is required)			
Dimensions of stack =	$\overline{R}$	$\overline{U}$	$\overline{B}$

Figure E-3.

At the bottom of the table in the spaces labeled "Dimensions of Stack," record the total number of units in each direction in the stack. This will aid in going through the random number table, because larger numbers in any column are not usable. Beginning at a random starting place in Appendix G, go down the column filling in the first column of the work table by using successive random numbers less than or equal to the dimension shown at the bottom of the work table. When the first column of the work table is completed, fill in the second column. When the bottom of a column is reached in Appendix G, begin at the top of the next column. If all dimensions of the stack are 10 or less, use one-digit columns of the random number table; if any dimension is greater than 10, but not greater than 100, use two-digit columns; if greater than 100, but not greater than 1000, use three-digit columns, and so on.

In the case of a three-dimensional lot numbering system, there is very little chance of duplicating all three numbers. Of course, if a set of three numbers should be found to duplicate an earlier entry, it should be replaced with the next available set.

If any dimension of the stack is "two", choose "one" if the random number in the table is odd and "two" if even. Alternatively, the random selection for that dimension can be made by successively tossing a coin rather than using the random number table.

For example, the dimensions of a stack are 10 by 7 by 3 and 10 packages are to be selectd at random. The office needs three one-digit numbers to locate each of the 10 samples in the stack. Assume that the random starting place is the 22nd column and the 45th row on page G-11 of Appendix G.

The first sample package is found 3 packages to the right, 7 packages up, and the third package back from the zero point.

The ninth sample package is 5 packages to the right, 5 packages up, and the second package back. (See completed example in Figure E-4.)

Figure E-4. Completed example of package selection using a three-dimensional lot numbering system

Package Selection Worksheet for a Three-Dimensional Lot Numbering System			
Sample package in the sequence to be used for tare determination	Package location		
	Right	Up	Back
1	3	7	3
2	5	3	1
3	7	1	3
4	10(0)	2	1
5	4	2	1
6	7	7	2
7	3	3	2
8	9	6	1
9	5	5	2
10	2	2	2
(continue if larger sample size is required)			
Dimensions of stack =	10 R	7 U	3 B

E.5. OTHER METHODS OR TABLES TO OBTAIN RANDOM NUMBERS

Random number dice may be used as an alternative to the random number table as a way of obtaining random numbers. These are special 20-sided dice sold and used in a set of three. Each die has 20 faces--two faces numbered 0, two faces numbered 1, etc., through the number 9. Two sources for purchasing the dice are:

Lansford Publishing Company[1]
P. O. Box 8711
San Jose, California 95155

Technovate[1]
910 Southwest 12th Avenue
Pompano Beach, Florida 33060

The random number dice can be used to get random numbers for the sample for serial lot-numbering systems if the lot contains 1000 packages or less, or for three-dimensional lot-numbering systems if no dimension is larger than 1000.

Other types of random number tables are helpful in choosing a random sample especially if the first digit of the lot size N is no greater than 5. For example, consider a lot of 200 serially numbered packages. Using the random number table in Appendix G requires elimination of all three-digit numbers over than 200. Since the numbers 0 to 9 occur with equal frequency, most of the random numbers in the table will be rejected. In such instances the book, Tables of Random Permutations, by Lincoln E. Moses and Robert V. Oakford (published by Stanford U. Press, Stanford, California in 1963) would be quite a time saver. In this book, a number of tables correspond to N with a small first digit (e.g., N = 10, 25, 50, 100), reducing the time to search (and the need to reject) many random numbers.

E.6. OTHER CONSIDERATIONS WHEN SELECTING THE SAMPLE

E.6.1. Selecting the Tare Sample

- The order in which numbers come out of the random number table determines those packages in the sample that are the tare sample.

  When testing glass or aerosol packages, it is very important, to retain the order of packages corresponding to the order in which the random numbers come out of the random number table, since the additional packages (if any) to be opened for tare are selected in this order.

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[1] The mention of firm names does not imply that they are endorsed or recommended by the Department of Commerce over other firms not mentioned.

The example worksheet shown on page E-4 provides a column labeled "Package Number in Lot." The random numbers are recorded in this column in the order in which they come from the random number table. The testing official will want to select the packages in the order corresponding to a serial arrangement of the numbers. One way of doing this and not forgetting the order of the packages for the tare sample (which, if glass or aerosol, could amount to a large proportion of the sample) is to associate each random number with the number printed to the left of it on a worksheet (page E-4 or E-6) and to order or mark the packages that are selected with this latter number. This number indicates the order in which the packages will be opened for tare. In the example of a package selection using a serial lot numbering system (referring to the example in Section E.4.), the package corresponding to random number 31 is the first package to be opened for tare, that package corresponding to random number 58 is the second and so on. However, in selecting the sample, the package corresponding to random number 2 may be the first removed from the lot. In this case, the official may wish to mark (or lay a piece of paper on) this first package removed from the lot with a "4". The second package removed from the lot in a serial fashion will be the package corresponding to the random number 31, but the inspector will want to note that this is the first package to be opened for tare determination.

o When testing at the packaging location, if dry tare is to be used, the tare sample should be selected from the same lot of tare materials into which the finished product (which is being checked) is being packaged. The major contribution to the tare weight (the can, cardboard box, etc.) should be selected randomly in the same fashion as the sample packages are selected. As long as they do not comprise a major proportion of the tare weight, supplementary tare materials in the finished package (solder, ties, glue, labels, caps, etc.) may be selected from the lot without rigorous random selection; however, such materials should be visually identical to and selected from the same batch as other such materials on the packaging line.

E.6.2. Selecting the Sample at Various Locations

- When the lot consists of packages on a retail shelf, a customer may remove packages from the lot while the official is choosing his sample. The official should continue choosing the sample as if a missing package had not been there initially (that is, by selecting the next package in sequence).

- It is permissible to eliminate individual packages from the sample (and from the inspection lot) if found to be defective by visual examination alone, e.g., cut boxes, empty bottles, torn wrappers, etc. Such individual packages should not become part of the sample. However, individual packages must not be eliminated from the sample after quantitative measurements have been made.

  If a defective package is found during sampling, the official may select a package immediately adjacent to the defective package. If found after selection, but before measurement, and the original package location is not conveniently accessible, the official may select another random number to identify a package for replacing the defective one in the sample.

- When the lot is defined as packages on open display plus cartons in a storeroom, the sample should be taken proportionately from the packages on the shelf and from the cartons. Thus, with 24 packages on display and 220 packages in the storeroom, approximately 1/10 of the sample should be from packages on display and 9/10 from packages in the storeroom. If there are to be 30 packages in the sample, 3 should come from the display and 27 from the storeroom.

- When the lot consists of cartons in a storage area or warehouse, the random sample can be obtained by using the three-dimensional lot numbering system. However, it may be extremely difficult to collect the sample if the packages are aggregated into larger storage units, such as cartons, strapped-together pallets, or shrink-packs.

  Therefore, for convenience, the official may randomly select more than one package from each carton, and more than one carton from each pallet. However, choosing the entire sample from a single pallet or a single carton must be strictly avoided.

The testing official may find it convenient to use the three-dimensional numbering system for selection of cartons on a pallet, and the serial numbering system for the selection of pallets and of packages from a carton.

The official should first choose the pallets (if any) from which the sample will be taken, then the cartons from those pallets (or from the entire lot if there are no pallets), and finally choose from the previously selected cartons, the individual packages that will comprise the sample. The number of units selected at each stage (pallet, carton, and package) does not have to be the same.

- When the lot consists of a portion of production at the packing plant, the packages coming off the packaging line can be considered to be numbered serially from 1 to N (the last package in the lot). Random numbers may be obtained from the random number table as described for serial lot numbering systems. The random numbers should be chosen, then ordered serially before physically choosing the packages corresponding to those numbers from the packing line.

APPENDIX F: AUXILIARY TABLE FOR RANDOM STARTING PLACE

Table provided by James F. Filliben, Statistical Engineering Division, National Bureau of Standards. Derived from A Million Random Digits by the Rand Corporation, coyright, 1955, The Free Press.

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(22,45)  ( 4,49)  (40, 7)  (44,20)  (21,45)  (17 42)  (10,26)  (27,26)  (20,31)  ( 1,13)  (18,42)  (50,20)
(26,44)  (50,38)  (23,35)  ( 9, 9)  (20,11)  (24,50)  (28,43)  ( 8,36)  (36,47)  (13,26)  (12,33)  (23,35)
(47,12)  ( 5,44)  (16,21)  (42,22)  (41, 2)  ( 1,20)  (33,34)  (43, 4)  (33,25)  ( 8,33)  (14, 2)  (12, 6)
( 8,20)  ( 8, 9)  (47,30)  (47,48)  ( 5,30)  (18, 9)  (15,35)  (42,10)  (34, 8)  (23,20)  (32,48)  (32, 4)
( 2,33)  (14,49)  ( 8,49)  (30,25)  (14,43)  ( 3,12)  (36,14)  (11, 3)  (29, 9)  (47,43)  (35,22)  (10, 6)

( 4,24)  (31,15)  (50,16)  (22,21)  (33,13)  (41, 9)  (27,42)  (18,13)  (24,42)  ( 5,46)  (45,32)  ( 3, 1)
(42,18)  (19,14)  (11,27)  (35,27)  (32, 5)  (34,49)  ( 9,19)  (47,32)  (16, 5)  (47,12)  ( 6,31)  (42,22)
( 2,38)  (28,41)  ( 8,43)  (19,19)  (37, 4)  (39,11)  (25,28)  ( 7,42)  (26, 4)  (20,50)  ( 7,26)  ( 4,26)
(14,49)  (29, 3)  ( 4,29)  (50,16)  (40, 7)  (20,35)  (15,46)  (37,21)  (37,48)  ( 1,35)  (48,36)  (28,35)
(28,15)  (22,41)  ( 5,25)  ( 5, 5)  ( 2, 8)  (43,38)  (19,23)  ( 6,14)  (47,43)  (32, 1)  ( 9, 1)  (28,48)

(40,27)  (10,19)  (48,29)  (15, 6)  (20,20)  ( 9, 5)  (43,23)  (19,12)  (34,42)  (38,34)  (23,42)  (12,35)
( 9,41)  (38,44)  (49,30)  (49, 7)  (41, 3)  (35, 9)  ( 6,26)  (35,50)  (10, 2)  (19,11)  ( 7,50)  ( 9,18)
(29,11)  (20,14)  ( 9,39)  (18,35)  ( 9,46)  (16,14)  (36,48)  (50,13)  ( 8,47)  (44,43)  (29,37)  (34,12)
(38,10)  (21,19)  (30,33)  (11,13)  ( 5,15)  (37, 2)  ( 6,13)  (50,16)  ( 8,20)  ( 3,12)  (16,44)  (31,27)
(23,28)  (47,43)  (40,25)  (47,48)  (18,20)  (34,17)  (39, 8)  (24,13)  ( 6,22)  (37,31)  (14, 4)  ( 1,39)

( 6,28)  (18,29)  (18,11)  ( 7, 8)  (31,10)  (49,28)  (43,42)  (19,16)  (41,26)  ( 6,42)  ( 1,36)  (26,42)
(14,17)  (38,37)  (35,37)  (35,34)  (21,27)  (34,43)  (50,10)  (11,12)  (13,30)  ( 8,33)  (15, 1)  (46,49)
(33,17)  (15,18)  (23,21)  (12,10)  (22,15)  (25,36)  (18,34)  (25,28)  (35,19)  (18,21)  ( 2,22)  (50,38)
(23,11)  (22, 3)  ( 5,18)  (24,34)  (18,48)  (20,22)  (10,31)  (31,45)  (47,43)  (29,39)  (35,23)  (19,35)
(39,47)  (47,31)  (38,31)  ( 1,39)  ( 7,26)  (47,20)  (17,14)  (44,15)  ( 3, 4)  (23,38)  (23,16)  (32,13)

(28,19)  (35,45)  (44, 9)  (16, 6)  (46, 3)  (26, 8)  (37, 7)  ( 9,21)  (46,38)  (15,42)  (33,46)  (24,18)
( 5,27)  (29,28)  (34,25)  (44,48)  (42, 8)  (12,46)  (27,24)  (49,34)  (17,12)  (15,12)  (19,41)  (44,42)
(19,48)  (39,40)  ( 2,41)  (44,23)  (46,26)  (27, 4)  (32,22)  (43, 4)  (27, 3)  ( 6, 8)  (20,28)  ( 4, 9)
(15,17)  (17,19)  (45,29)  (21,16)  (34,27)  (15,29)  ( 8,19)  (41,32)  (29,48)  (14,30)  (27,11)  (17,49)
( 9,38)  (43, 7)  (25,38)  ( 9,29)  (33, 3)  (38,38)  (27,16)  ( 2,17)  ( 3,16)  ( 9,24)  (25,19)  ( 9, 8)

(17, 9)  (44,49)  (23, 6)  (13,13)  (48,30)  (44,30)  (30,28)  (19,47)  (13,37)  (25,33)  (25,39)  ( 7,10)
(14,24)  (35,17)  (22,45)  (49,12)  ( 8,24)  ( 3,33)  ( 2,48)  (41,47)  (40,27)  (47,10)  (12,18)  (14, 1)
(19,27)  (26,21)  (49,37)  ( 2,48)  ( 1,48)  (31, 6)  ( 1,39)  (17,20)  (28, 6)  (42,26)  ( 3,18)  (16,18)
(34,42)  (30,17)  (21, 5)  ( 7,10)  (36,40)  (13,23)  (33,40)  ( 5,44)  (47, 5)  (19,39)  (24, 2)  (31,40)
( 5,18)  (36,15)  (14,18)  (25, 5)  (15,50)  (18,13)  (22,48)  (28,26)  (48,32)  (32,23)  (16,26)  ( 8, 4)

( 4,15)  (34,27)  (43,15)  (42,19)  (45,14)  (25, 1)  (15,37)  (50,29)  (32,28)  (36,22)  ( 1,11)  (19,37)
( 1, 6)  (33,45)  (10,21)  (34,50)  (32, 6)  (46,34)  (35, 9)  ( 7, 9)  (46,39)  (30, 2)  (48,21)  (44,33)
( 8,38)  (15,50)  (19,44)  (50,47)  (33,16)  (49,27)  ( 5,23)  (50,32)  (44,50)  (14, 2)  (29,46)  ( 6,43)
( 9,27)  (18, 7)  (29,19)  (46,39)  (28,46)  (20,45)  (48,48)  ( 8,49)  (26,16)  (48,16)  (20,24)  ( 6,11)
( 2,27)  (33,13)  (25,26)  (24,43)  (21,12)  (10,31)  (21,16)  (15,35)  (26,16)  (44,22)  (46,44)  ( 5,16)

(37,23)  (27,26)  (29,49)  (47,45)  (16,42)  (29,37)  (47,29)  ( 1,36)  (38,37)  (41,47)  (49,35)  (35, 5)
(27, 1)  (40,49)  (28,32)  ( 3,10)  (36,16)  (44,38)  (27,47)  (15,27)  ( 1, 7)  (25, 5)  (28, 4)  (28,41)
(32,37)  (23,36)  (20, 4)  (34,48)  (33,37)  (47,39)  (14,30)  (27,28)  (24, 5)  (44,11)  (29,36)  (14, 7)
( 9,34)  (26,10)  (46,20)  (41,20)  (24, 4)  (13, 4)  (33,10)  (19,14)  (28, 8)  (42,41)  ( 3,41)  ( 2,30)
( 1,19)  (37,35)  (10,25)  (17,37)  (23,10)  (31, 5)  (42,30)  (32, 3)  (22,37)  (17,18)  ( 3,25)  ( 1,13)

(25,38)  (14,10)  (25, 3)  (42,20)  (21,50)  (10, 9)  (24,23)  (10, 6)  (17,15)  (26,49)  (24,45)  (19,40)
(21,37)  (25, 8)  (48,49)  (39,19)  (42,42)  (18, 8)  (27,48)  (27,48)  ( 1,27)  (20,37)  (34, 6)  (28, 3)
(33,11)  (20,10)  (37,32)  (31,21)  ( 4,45)  (11,42)  (27,28)  (35, 1)  (50,10)  (47,26)  (13,23)  (35,31)
(13,26)  (28, 7)  ( 8, 2)  ( 2, 7)  (24,29)  (16,31)  ( 5,22)  (38,19)  (44,10)  (19,23)  (41,25)  (12,11)
(18,13)  (42, 7)  (19,40)  ( 6,48)  (46,39)  ( 6,10)  (40,24)  (29,23)  (38,23)  ( 8,18)  (27,37)  (32,2[illegible])

(31,12)  (46,33)  (26,31)  (15,23)  (19,39)  ( 9,33)  ( 5,28)  (17, 6)  ( 9,42)  (17, 7)  ( 2, 1)  (11,42)
(19,36)  (11,33)  (31,18)  ( 3,30)  (49,26)  (27, 9)  (48,44)  (30,19)  (19,38)  (18,41)  ( 9,42)  (46, 3)
(48, 8)  ( 3,14)  (32,28)  (50,48)  (43,33)  ( 7,22)  (25, 7)  (49,19)  (10,40)  (21,50)  (28,32)  (46,19)
(19,21)  (15,25)  (47,26)  (40,23)  (47,23)  (44, 9)  (45,23)  (31,30)  (19, 2)  (23, 9)  (38, 4)  (21,38)
( 8,43)  (20,27)  (31,46)  (44,34)  (32,48)  (37,40)  (44,34)  ( 3, 5)  (36,45)  (34,21)  (23,21)  (25, 4)
```

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(50,33)   ( 6,14)   (16,45)   (37,11)   (50,36)   (49,11)   (28,18)   ( 7,21)   (21,38)   (13, 9)   (47,41)   (11,21)
(31,16)   (44,37)   (21, 1)   (47, 9)   (49,15)   (23,20)   (25, 4)   (48,32)   (49,40)   (27,19)   (37, 2)   (14,22)
(44,11)   (28, 7)   (19,36)   (37, 6)   (42,43)   ( 5, 3)   (13,29)   (10,10)   (28,13)   (42,31)   (47, 6)   ( 2,31)
( 4,46)   ( 6,14)   ( 9,48)   (37,50)   (47,37)   (35, 3)   (15,29)   (33,33)   (34,40)   (46,48)   (37,39)   (50,40)
( 7,21)   (30,34)   (23,47)   (37,27)   (17,25)   (47,38)   (20, 1)   (41,45)   (30, 5)   ( 6,42)   (20,28)   (32, 2)

(23,32)   (34, 9)   (17,24)   (13,15)   (16,14)   (50,19)   (14, 7)   (19,24)   ( 3,25)   (17,26)   (36,26)   (15, 7)
(37, 2)   (28,11)   (35,11)   (18,47)   (46,11)   (31,18)   ( 5, 1)   (30,27)   (10,15)   (27,16)   (33,28)   (41,37)
( 5,15)   (39,43)   (19,28)   (49,49)   (47,12)   (29,31)   ( 8,22)   (30,44)   (14, 9)   (44,36)   ( 7, 9)   (22,17)
(14,13)   (21,49)   (46,19)   ( 2,29)   (14,40)   (49, 7)   ( 9,33)   (31, 2)   (40,46)   (22,39)   (22,50)   (41,36)
(35,44)   (37,44)   (23,19)   (47, 6)   (21,47)   (40,33)   (46, 9)   (17,47)   (38,38)   (38, 5)   (14,31)   (31, 7)

(13,14)   (45,32)   (23,20)   (15,35)   (44,21)   (14,18)   ( 9,11)   (50,46)   ( 5, 3)   (28,40)   ( 2,24)   (43,15)
(27,11)   (35, 5)   (24,23)   (39,20)   (40,23)   (47, 3)   ( 9,31)   (31,45)   (16, 9)   (44,42)   (19,17)   ( 9,35)
(35,34)   (27,13)   ( 9,27)   (32,30)   (36,32)   (15, 7)   (49, 6)   (47,39)   (28,33)   ( 6, 6)   (41, 6)   (35,16)
(24,28)   (38, 3)   (11,24)   ( 9,46)   (27,40)   (17,23)   (19,38)   (35,30)   ( 6,50)   (33,16)   (32,15)   (49,17)
(37,27)   (40, 6)   (40,38)   (35,32)   (42,45)   ( 7,48)   (34,29)   (13, 3)   (26,14)   ( 9,23)   (38,18)   (29,11)

(29,13)   (13,28)   (15, 1)   (25,22)   (36,42)   (34,39)   (32,33)   (14,21)   (24,42)   (29,28)   (42,10)   (24,20)
(33,36)   ( 7, 9)   (28,24)   (49,39)   (45,32)   (50,45)   ( 7,33)   (38,47)   (50,31)   (49,25)   (17, 6)   (27,49)
(39,17)   (28,42)   (45,25)   (20,46)   ( 4,28)   (44,48)   (26,20)   (18,10)   (47,48)   (17,43)   ( 8, 4)   (27,45)
(17,16)   ( 9,20)   (38,45)   (23, 1)   (45,34)   (10, 1)   (34,50)   (35,42)   ( 4,30)   (14, 3)   (46,41)   (42,28)
(42, 1)   (40,42)   (28,28)   (42,23)   (15,32)   ( 9,17)   ( 4,16)   (40,15)   (36,24)   ( 3,35)   (34,12)   (27,36)

(24,16)   (41, 7)   (16, 7)   (45,35)   ( 1,23)   (25,29)   (38,20)   (43,29)   (30,43)   (29,31)   (17,30)   (18,36)
(34,23)   (44,22)   (15,25)   (23,25)   (18,18)   (36,17)   (20,15)   ( 5,34)   (49,14)   ( 9,11)   (44,41)   (29,44)
(11,44)   (16,41)   (29,31)   (44,19)   (45,18)   (30,16)   (24,42)   ( 7,15)   (19,47)   ( 7,26)   (50,43)   (27,19)
(22, 6)   ( 3,30)   (26,36)   (38,33)   (40,34)   (39,48)   (14,40)   (28,16    (13,10)   (37,20)   (28,13)   (35,34)
(28,43)   (44,48)   (32,38)   (41,35)   ( 8, 4)   (11,42)   (20,33)   (41,23)   (30,32)   ( 9, 2)   (44,41)   ( 4,30)

(43,39)   (43,44)   (12,13)   ( 7, 1)   ( 3, 2)   ( 2,38)   (15,47)   (17,44)   (15,14)   (10,32)   (27,14)   (35,24)
(13,35)   (17,19)   (17,12)   (37,12)   (33,36)   (41,26)   ( 4,12)   (39,14)   (23,37)   ( 4, 6)   (19,40)   (26,41)
(22,34)   (12,30)   (20, 2)   (19,34)   (20,26)   ( 6,30)   (25,29)   (19,29)   (48,49)   (49,11)   ( 6,14)   (14,27)
(26, 4)   ( 8,29)   (36,23)   (18,10)   (30,25)   (34,12)   (48,42)   (41,24)   (11,32)   (28,31)   (29,43)   (39,17)
(21, 1)   (40,49)   (15,15)   ( 5,50)   (36,41)   (35,36)   ( 9,31)   (25,36)   ( 9,10)   (47,18)   (11,41)   (23,21)

(12, 5)   (43,39)   ( 4,29)   (23,19)   (19,48)   ( 4,32)   (28,32)   (38,16)   (44,50)   (39,47)   (36,25)   (50,33)
(24,15)   (27,38)   (14,15)   (33,20)   (25,37)   (38, 1)   (47,48)   (14,13)   (45,18)   (32,44)   (37, 6)   (38,37)
(17,41)   ( 7,41)   (30,27)   (36,44)   (50,20)   (10, 4)   ( 3,22)   (20,30)   (32,49)   ( 3,30)   (33,12)   (16,36)
(19,30)   (10,26)   (49,40)   (31,18)   ( 1,20)   (21,11)   (11,13)   (16,45)   (46,12)   ( 4,40)   (44,38)   (22, 2)
(38,38)   (11,41)   (34, 1)   (12,10)   (44,42)   (41,38)   ( 3,49)   (11, 4)   (39,24)   (28,38)   (15,46)   (46,31)

(31,28)   (30,21)   ( 2,20)   ( 8,34)   (39,48)   ( 3,50)   (28,17)   (41,49)   (11,12)   (29, 7)   (13,19)   (48,40)
(30,14)   ( 6,35)   (31,20)   ( 5, 2)   (15,11)   (24,28)   (27,12)   ( 7,20)   (23, 2)   (14,32)   (25,13)   (49, 6)
(50,39)   (29,30)   ( 2,23)   (24,36)   (17,30)   (20,45)   (22,22)   (46,16)   ( 6,37)   (28,10)   (14,30)   (27,25)
(20, 8)   (38,42)   (16,16)   (36, 1)   (47,48)   ( 3, 1)   (13,46)   (12,14)   (15,17)   (25,24)   (12,30)   ( 2,29)
( 5, 8)   (20, 7)   (27,12)   (10, 8)   ( 6,42)   (27, 6)   (15,27)   (50,27)   ( 1,43)   (44,45)   (44,39)   (47, 9)

(34,41)   (34,12)   (27,33)   (26, 5)   (46,11)   ( 7,25)   (20,30)   ( 7,47)   (50,46)   (13,30)   (13,43)   (11,23)
( 5,15)   (50,15)   ( 4,19)   (25, 5)   (33,11)   (41,36)   (44,16)   (38,28)   ( 9,42)   (47, 5)   ( 2, 3)   ( 3,36)
( 7,50)   (47, 7)   (41,36)   (24,34)   (12,18)   (14,47)   (11,24)   (27,31)   (48,20)   (31,25)   (14,47)   (43,19)
(23, 8)   (24,18)   (36,16)   (33,39)   (12,50)   (29,24)   ( 8,45)   (40,28)   ( 6,45)   (36,14)   (22,11)   (50,27)
(32,40)   (41,41)   ( 1, 6)   ( 3,48)   (46,21)   (15,41)   (39,21)   (46,20)   (38,16)   (37,49)   (25, 2)   (34,35)

(20,11)   (18,50)   (21,46)   ( 9,42)   (11,11)   (42, 5)   ( 9, 1)   (33,19)   (20,28)   (15,13)   (46, 1)   (24,10)
(20,49)   (29,46)   (40,49)   (42,50)   (30,19)   (14,33)   ( 6,13)   (48,35)   (14,27)   ( 2,41)   (37,49)   (41,37)
( 9,38)   (15,39)   (47, 4)   ( 1,25)   (30,31)   (45,17)   (28,35)   (49,36)   (46,25)   (10,47)   ( 7,11)   (48, 2)
( 3,15)   (24,20)   (14, 4)   (27,19)   ( 3,29)   (21,17)   (46,34)   (15,49)   (26,11)   ( 6, 9)   (47,18)   (26,24)
( 2,23)   ( 5,39)   (44,19)   (21,32)   (23,21)   (19,21)   (44,20)   (19,19)   (25, 5)   (36,15)   ( 3, 5)   (25,27)
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APPENDIX G: RANDOM NUMBER TABLE

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TABLE OF RANDOM DIGITS

31000	63837	17813	08076	19164	95508	17513	29416	61238	25818
87014	83331	56364	32768	85680	08844	59844	68794	32783	60318
47293	97023	35804	69886	47494	94574	45842	67221	77115	43398
33898	89236	06100	68848	08674	87786	42425	92091	86274	82166
26877	95856	65227	25165	01752	99463	15216	28719	04716	80246
53984	87855	70753	80386	78600	39244	76967	83263	57849	85890
97809	03548	00574	21143	11605	30245	87395	80966	28721	11095
85683	79483	74858	87491	57785	61270	51111	50490	40940	02832
07758	57784	22934	17165	37776	33361	79191	97398	40881	98552
13995	74006	90843	85761	89037	13567	67089	47435	75156	70217
89630	94575	64517	80897	04861	50564	15287	94279	69154	75473
20355	08661	11092	19682	84287	23597	48246	74325	66320	90155
13496	74367	32701	87819	29050	90959	99765	59374	45204	87750
68419	49317	30340	62744	45214	79826	34043	73218	72788	26143
61481	09786	08768	93715	43847	68901	51249	35382	67776	06271
71877	53924	09630	62975	64470	46832	40591	23477	21063	31229
99283	86530	86819	38955	91744	89632	64623	84986	85990	47639
09047	83453	12775	32000	60098	98862	93422	66212	86413	82884
83724	89682	53950	41500	16023	83862	88274	68301	99673	40945
56126	46618	87708	91994	38384	27047	91550	18903	45535	45586
13810	51503	55122	22997	82556	22697	54985	64852	58775	66737
85630	22794	81623	10927	52252	27384	03122	17454	03250	23232
93350	28643	39097	00914	69844	06450	32818	88752	28722	94656
05002	71178	15414	99874	58046	35461	56349	81936	14964	83638
70358	57182	45747	30830	70542	25932	16298	23521	72454	11640
98169	51114	18115	40718	46082	75847	15678	22842	44615	97810
28010	95831	94028	57041	75137	55128	99785	33467	33834	04860
05576	47156	09300	11197	97670	20064	98145	84774	07907	10992
80748	66311	79421	00202	68501	40422	07368	26795	24358	78969
39746	23690	67845	83962	09451	21501	75317	09049	69440	16137
39380	72397	88106	07851	67756	58042	44218	52775	49082	54400
55865	70318	58189	35340	91500	80940	39231	54836	18038	03557
34223	72744	83926	40078	80791	42723	68340	47452	17443	69289
91312	44474	09925	41416	96671	11213	60979	04130	72380	73582
51010	08021	53914	37499	40228	92606	07225	18014	71063	50111
48890	58264	18790	91535	04933	56656	76389	37904	98017	07663
24876	93198	77444	53782	48866	65614	11410	90637	63675	43554
49408	42923	28162	09789	15155	66742	66785	79065	93573	19853
56307	90901	18117	36505	01598	68997	96338	40823	96247	55573
48320	09322	13457	84931	54701	14878	05422	65358	85636	31948
51083	00619	05548	25431	15175	82428	00637	41814	68871	31688
43249	71593	85595	59834	01488	06917	32858	80134	01832	25905
00370	17413	75537	79824	24428	28941	58659	66731	99940	27156
55737	45462	12484	64858	43581	06220	07507	39119	38024	99720
39551	38058	10445	18463	80812	51243	22351	63266	94057	06573
02369	11289	99499	32922	88429	90484	42010	53308	33206	36137
92788	62546	26147	83529	10012	77611	78925	86071	66344	35705
98650	95898	74254	45173	17430	73882	03411	88447	43279	35057
95591	85858	51058	26140	00995	16881	87372	72646	18796	58537
67853	23563	41063	63355	72454	16016	72229	54720	09846	81392

TABLE OF RANDOM DIGITS

32942	95416	42339	59045	26693	49057	87496	20624	14819	48667
07410	99859	83828	21409	29094	65114	36701	25762	12827	45692
59981	68155	45673	76210	58219	45738	29550	24736	09574	35036
46251	25437	69654	99716	11563	08803	86027	51867	12116	38469
65558	51904	93123	27887	53138	21488	09095	78777	71240	87225
99187	19258	86421	16401	19397	83297	40111	49326	81686	40601
35641	00301	16096	34775	21562	97983	45040	19200	16383	68739
14031	00936	81518	48440	02218	04756	19506	60695	88494	58501
60677	15076	92554	26042	23472	69869	62877	19584	39576	18290
66314	05212	67859	89356	20056	30648	87349	20389	53805	85243
20416	87410	75646	64176	82752	63606	37011	57346	69512	56464
28701	56992	70423	62415	40807	98086	58850	28968	45297	80419
74579	33844	33426	07570	00728	07079	19322	56325	84819	48754
62615	52342	82968	75540	80045	53069	20665	21282	07768	60375
93945	06293	22879	08161	01442	75071	21427	94842	26210	95002
75689	76131	96837	67450	44511	50424	82848	41975	71663	79656
02921	16919	35424	93209	52133	87327	95897	65171	20376	13475
14295	34969	14216	03191	61647	30296	66667	10101	63203	75144
05303	91109	82403	40312	62191	67023	90073	83205	71344	96216
57071	90357	12901	08899	91039	67251	28701	03846	94589	88403
78471	57741	13599	84390	32146	00871	09354	22745	65806	78187
89242	79337	59293	47481	07740	43345	25716	70020	54005	23973
14955	59592	97035	80430	87220	06392	79028	57123	52872	94991
42446	41880	37415	47472	04513	49494	08860	08038	43624	46013
18534	22346	54556	17558	73689	14894	05030	19561	56517	96479
39284	33737	42512	86411	23753	29690	26096	81361	93099	33868
33922	37329	89911	55876	28379	81031	22058	21487	54613	81052
78355	54013	50774	30666	61205	42574	47773	36027	27174	44830
08845	99145	94316	88974	29828	97069	90327	61842	29604	47994
01769	71825	55957	98271	02784	66731	40311	88495	18821	12463
17639	38284	59478	90409	21997	56199	30068	82800	69692	45133
05851	58653	99949	63505	40409	85551	90729	64938	52403	56841
42396	40112	11469	03476	03328	84238	26570	51790	42122	40874
13318	14192	98167	75631	74141	22369	36757	89117	54998	87031
60571	54786	26281	01855	30706	66578	32019	65884	58485	10909
09531	81853	59334	70929	03544	18510	89541	13555	21168	81318
72865	16829	86542	00396	20363	13010	69645	49608	54738	17894
56324	31093	77924	28622	83543	28912	15059	80192	83964	61904
78192	21626	91399	07235	07104	73652	64425	85149	75409	67104
64666	34767	97298	92708	01994	53188	78476	07804	62404	34828
82201	75694	02808	65983	74373	66693	13094	74183	73020	31086
15360	73776	40914	85190	54278	99054	62944	47351	89098	26735
68142	67957	70896	37983	20487	95350	16371	03426	13895	42170
19138	31200	30616	14639	44406	44236	57360	81644	94761	92813
28155	03521	36415	78452	92359	81091	56513	88321	97910	22235
87971	29031	51780	27376	81056	86155	55488	50590	74514	58791
58147	68841	53625	02059	75223	16783	19272	61994	71090	78416
18875	52809	70594	41649	32935	26430	82096	01605	65846	65228
75109	56474	74111	31966	29969	70093	98901	84550	25769	82586
35983	03742	76822	12073	59463	84420	15868	99505	11426	62723

TABLE OF RANDOM DIGITS

12651	61646	11769	75109	86996	97669	25757	32535	07122	76763
81769	74436	02630	72310	45049	18029	07469	42341	98173	79260
36737	98863	77240	76251	00654	64688	09343	70278	67331	98729
82861	54371	76610	94934	72748	44124	05610	53750	95938	01485
21325	15732	24127	37431	09723	63529	73977	95218	96074	42138

74146	47887	62463	23045	41490	07954	22597	60012	98866	90959
90759	64410	54179	66075	61051	75385	51378	08360	95946	95547
55683	98078	02238	91540	21219	17720	87817	41705	95785	12563
79686	17969	76061	83748	55920	83612	41540	86492	06447	60568
70333	00201	86201	69716	78185	62154	77930	67663	29529	75116

14042	53536	07779	04157	41172	36473	42123	43929	50533	33437
59911	08256	06596	48416	69770	68797	56080	14223	59199	30162
62368	62623	62742	14891	39247	52242	98832	69533	91174	57979
57529	97751	54976	48957	74599	08759	78494	52785	68526	64618
15469	90574	78033	66885	13936	42117	71831	22961	94225	31816

18625	23674	53850	32827	81647	80820	00420	63555	74489	80141
74626	68394	88562	70745	23701	45630	65891	58220	35442	60414
11119	16519	27384	90199	79210	76965	99546	30323	31664	22845
41101	17336	48951	53674	17880	45260	08575	49321	36191	17095
32123	91576	84221	78902	82010	30847	62329	63898	23268	74283

26091	68409	69704	82267	14751	13151	93115	01437	56945	89661
67680	79790	48462	59278	44185	29616	76531	19589	83139	28454
15184	19260	14073	07026	25264	08388	27182	22557	61501	67481
58010	45039	57181	10238	36874	28546	37444	80824	63981	39942
56425	53996	86245	32623	78858	08143	60377	42925	42815	11159

82630	84066	13592	60642	17904	99718	63432	88642	37858	25431
14927	40909	23900	48761	44860	92467	31742	87142	03607	32059
23740	22505	07489	85986	74420	21744	97711	36648	35620	97949
32990	97446	03711	63824	07953	85965	87089	11687	92414	67257
05310	24058	91946	78437	34365	82469	12430	84754	19354	72745

21839	39937	27534	88913	49055	19218	47712	67677	51889	70926
08833	42549	93981	94051	28382	83725	72643	64233	97252	17133
58336	11139	47479	00931	91560	95372	97642	33856	54825	55680
62032	91144	75478	47431	52726	30289	42411	91886	51818	78292
45171	30557	53116	04118	58301	24375	65609	85810	18620	49198

91611	62656	60128	35609	63698	78356	50682	22505	01692	36291
55472	63819	86314	49174	93582	73604	78614	78849	23096	72825
18573	09729	74091	53994	10970	86557	65661	41854	26037	53296
60866	02955	90288	82136	83644	94455	06560	78029	98768	71296
45043	55608	82767	60890	74646	79485	13619	98868	40857	19415

17831	09737	79473	75945	28394	79334	70577	38048	03607	06932
40137	03981	07585	18128	11178	32601	27994	05641	22600	86064
77776	31343	14576	97706	16039	47517	43300	59080	80392	63189
69605	44104	40103	95635	05635	81673	68657	09559	23510	95875
19916	52934	26499	09821	87331	80993	61299	36979	73599	35055

02606	58552	07678	56619	65325	30705	99582	53390	46357	13244
65183	73160	87131	35530	47946	09854	18080	02321	05809	04898
10740	98914	44916	11322	89717	88189	30143	52687	19420	60061
98642	89822	71691	51573	83666	61642	46683	33761	47542	23551
60139	25601	93663	25547	02654	94829	48672	28736	84994	13071

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42902	51104	38993	54071	75033	43897	24684	62233	05749	76653
82989	95401	97093	57790	09271	05895	27692	65558	28890	75645
13523	66327	39522	83279	50432	88392	37826	81599	97612	34122
74785	72548	36886	97749	52364	78430	15990	86418	53689	73170
77739	44753	03957	53267	13225	89471	59481	53923	52588	54986
58236	98093	81969	21510	20727	91655	23601	77178	43468	77172
94641	38922	76016	66041	92109	76430	07105	45987	62177	37542
15317	99242	46970	58119	15178	10125	89295	83401	28737	53214
00624	09824	83319	26428	69711	71980	77666	57012	83722	06961
23295	02389	05795	70981	05664	32846	99935	81786	90285	03818
70292	13217	90859	05792	09833	49409	45496	62194	98232	59969
08550	22580	43519	51755	50308	68330	70244	27806	33662	90457
94981	10727	29544	37001	02751	82481	33622	89729	10488	54507
70318	46657	73496	92074	63918	13428	13249	68163	31082	72138
27510	92421	43020	79733	81369	11801	43094	91733	79865	67010
41289	29535	33408	05708	76999	37772	97740	44905	16840	25538
37586	71952	19967	77327	45052	16811	52264	09700	08766	08450
65737	05451	24726	95840	89663	37418	31034	44631	02044	89446
87473	53058	80611	24464	50379	93555	80327	29829	75884	69962
89920	40997	03736	00992	80443	12071	57996	42605	92034	89189
10203	39157	90207	07120	19280	37862	96041	66652	05173	59475
63864	57186	93586	52497	32459	85507	19646	80758	31519	71022
45006	51623	30675	56395	67037	33850	94000	57166	88739	92350
01839	83286	87159	72173	69624	75457	95469	48064	31695	17608
07708	41627	62416	05579	87013	84309	56068	84979	78592	36446
17655	18629	94121	20967	82561	65520	87874	72484	86640	33610
96137	55079	15672	21474	22403	74557	10290	39575	62266	10125
66495	22010	73641	70391	31391	43927	45219	38479	80100	82717
54585	37425	12794	71143	65025	74706	30555	42290	45357	08567
28180	01067	68577	99878	01960	86209	95045	62490	34554	65505
44655	45433	72815	11383	27507	80064	26860	44549	42538	48425
31321	57930	02748	46178	27490	65081	97037	67297	54273	67483
36218	26166	64389	39466	53435	89404	45328	34152	24787	98162
06853	28955	15516	22467	54482	70997	37271	13166	32827	29958
45231	95235	00120	85500	41753	36053	04285	77365	33273	97811
60484	63181	83125	42402	86905	40988	25091	68407	18356	62600
83577	81518	87638	08719	84819	15068	60067	48628	46522	78010
09724	39466	80440	69636	37481	20907	90064	06280	57942	71723
58504	66886	64596	23484	25596	43400	04787	54631	05421	50230
37033	02248	28174	29215	51118	04863	23752	10000	33331	62358
28026	12852	46235	15058	00222	26478	73671	81592	18436	67676
12831	55496	60299	47364	52600	02906	93295	27011	42904	33856
14507	71736	33817	42164	89793	67645	06609	22483	49017	99946
82424	22539	73202	32091	97375	11126	75877	89720	88213	65129
59133	35497	25135	24968	93294	12442	89020	11700	42936	43010
72031	14923	44610	70690	35644	97897	16835	41673	63777	90758
65161	59905	40133	95680	78737	93726	95312	18215	20184	84289
50062	64153	20669	81461	80140	88536	24552	78781	39807	00018
18116	19026	22965	39908	30649	91235	27259	08470	77321	12795
29105	00954	71562	10193	41802	53790	85828	60565	09835	42761

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43398	79666	37687	36431	34822	00779	38828	71137	85054	64660
78711	15270	42232	87128	31711	77482	85873	17317	94357	78210
54489	52503	11005	00067	23146	44973	39257	65815	13929	77081
17324	40078	14214	19160	25276	05125	52020	97099	77116	45921
67297	25163	16386	62687	07398	18963	60035	35598	14404	14872
56959	16184	32709	57507	92221	82925	46064	94665	73523	23638
78207	34228	39440	67765	80627	08869	05514	24215	65237	82139
99508	47528	01328	67220	50824	47847	69726	75453	08780	53120
66199	99811	13887	31301	41034	63717	10310	33607	01858	28266
91987	73491	22639	94096	01702	48093	35976	93334	17638	65818
80125	84984	47804	90908	11106	43995	83182	39647	41504	23286
69743	16618	59364	73113	89143	89412	39331	84989	92091	01383
41686	85487	91526	28591	54635	77149	59117	30291	68266	65760
80967	75537	81999	02257	62232	00956	24954	88932	90733	35767
24148	95247	12340	39407	71596	53961	61089	68699	38891	87153
22989	64262	12716	32910	32303	18783	65166	56622	93342	14032
54147	01638	95954	66666	30544	67089	04524	19251	57440	69100
07529	10668	23743	02743	10252	47893	83969	54252	47327	31685
36379	13588	44587	31015	34971	25146	33188	05218	17157	65663
38653	73761	61363	95667	03372	35800	58711	15872	33342	02963
72327	65811	53782	01608	38741	58353	51594	48982	85028	75444
41133	06312	13340	18870	27204	83187	91970	91498	17234	52283
15039	81095	50787	28452	61100	39538	25225	92624	18517	77361
40499	67587	16761	25929	43836	43466	80409	95407	46777	22668
46910	72907	18515	12710	11580	52823	95769	71506	39644	66877
15009	81751	07942	14046	54993	68001	13782	91933	61130	61752
10538	10295	62995	16527	55334	05736	92168	35393	01026	26984
70204	91225	78307	55577	78715	54507	21486	26920	52995	98095
30403	98849	55318	99947	23625	74643	85157	45893	49287	03567
75147	49930	47054	08485	91397	25614	83669	08353	61573	49629
20770	53498	05412	19184	25997	06100	27128	43137	77812	13101
51096	90416	18721	42390	31517	28366	30073	89021	40881	36162
05027	43924	37581	31418	57010	05808	75544	68156	75440	64496
22013	11299	76690	92730	10867	12748	58655	44844	11933	16752
50232	30821	45382	85723	15635	85910	19874	61262	74598	41321
20724	99075	91270	13936	74962	15346	05181	52254	42138	18237
65692	61084	48856	34766	09098	87381	29763	65051	91174	80750
81215	08824	06387	10900	83463	19773	83029	81689	66067	38729
86127	96878	53819	10715	67213	53160	17249	44596	76354	33601
26483	16992	89421	15216	71632	83429	96263	16342	15595	48978
84697	87543	67935	72389	18299	93559	90668	86972	42632	40502
89691	53802	42595	31089	20914	80542	96241	14487	84488	74117
20295	92548	68410	15006	02091	78176	67889	32552	62792	30147
98925	64297	94922	26349	58805	55911	80640	74650	71207	14412
53560	52945	68649	31696	69387	62573	15635	23958	75948	59883
45034	92695	98157	83536	55140	91189	98557	21505	89477	32010
35222	86197	20082	60378	05392	41064	08418	28472	39593	19710
08071	77462	20243	55151	02607	78441	12897	76800	62801	62770
54802	07781	29975	44720	62534	16601	78043	70078	13691	09599
84209	92329	32234	11385	09067	99793	84549	50498	13340	41986

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07018	31172	12572	23968	55216	85366	56223	09300	94564	18712
52444	65625	97918	46794	62370	59344	20149	17596	51669	47429
72161	57299	87521	44351	99981	55008	93371	60620	66662	27036
17918	75071	91057	46829	47992	26797	64423	42379	91676	75127
13623	76165	43195	50205	75736	77473	07268	31330	07337	55901
27426	97534	89707	97453	90836	78967	00704	85734	21776	85764
96039	21338	88169	69530	53300	29895	71507	28517	77761	17244
68282	98888	25545	69406	29470	46476	54562	79373	72993	98998
54262	21477	33097	48125	92982	98382	11265	25366	06636	25349
66290	27544	72780	91384	47296	54892	59168	83951	91075	04724
53348	39044	04072	62210	01209	43999	54952	68699	31912	09317
34482	42758	40128	48436	30254	50029	19016	58837	05206	33851
99268	98715	07545	27317	52459	75366	43688	27460	65145	65429
95342	97178	10401	31615	95784	77026	33087	65961	10056	72834
38556	60373	77935	64608	28949	94764	45312	71171	15400	72182
39159	04795	51163	84475	60722	35268	05044	56420	39214	89822
41786	18169	96649	92406	42773	23672	37333	85734	99886	81200
95627	30768	30607	89023	60730	31519	53462	90489	81693	17849
98738	15548	42263	79489	85118	97073	01574	57310	59375	54417
75214	61575	27805	21930	94726	39454	19616	72239	93791	22610
73904	89123	19271	15792	72675	62175	48746	56084	54029	22296
33329	08896	94662	05781	59187	53284	28024	45421	37956	14252
66364	94799	62211	37539	80172	43269	91133	05562	82385	91760
68349	16984	86532	96186	53893	48268	82821	19526	63257	14288
19193	99621	66899	12351	72438	99839	24228	32079	53517	18558
49017	23489	19172	80439	76263	98918	59330	20121	89779	58862
76941	77008	27646	82072	28048	41589	70883	72035	81800	50296
55430	25875	26446	25738	32962	24266	26814	01194	48587	93319
33023	26895	65304	34978	43053	28951	22676	05303	39725	60054
87337	74487	83196	61939	05045	20405	69324	80823	20905	68727
81773	36773	21247	54735	68996	16937	18134	51873	10973	77090
74279	85087	94186	67793	18178	82224	17069	87880	54945	73489
34968	76028	54285	90845	35464	68076	15868	70063	26794	81386
99696	78454	21700	12301	88832	96796	59341	16136	01803	17537
55282	61051	97260	89829	69121	86547	62195	72492	33536	60137
31337	83886	72886	42598	05464	88071	92209	50728	67442	47529
94128	97990	58609	20002	76530	81981	30999	50147	93941	80754
06511	48241	49521	64568	69459	95079	42588	98590	12829	64366
69981	03469	56126	80405	97485	88251	76708	09558	86759	15065
23701	56612	86307	02364	88677	17192	23082	00728	78660	74196
09237	24607	12817	98120	30937	70666	76059	44446	94188	14060
11007	45461	24725	02877	74667	18427	45658	40044	59484	59966
60622	78444	39582	91930	97948	13221	99234	99629	22430	49247
79973	43668	19599	30021	68572	31816	63033	14597	28953	21162
71080	71367	23485	82364	30321	42982	74427	25625	74309	15855
09923	26729	74573	16583	37689	06703	21846	78329	98578	25447
63094	72826	65558	22616	33472	67515	75585	90005	19747	08865
19806	42212	41268	84923	21002	30588	40676	94961	31154	83133
17295	74244	43088	27056	86338	47331	09737	83735	84058	12382
59338	27190	99302	84020	15425	14748	42380	99376	30496	84523

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29257	36060	81080	67493	23666	22251	17616	60716	77125	18653
04426	95304	83272	18379	46498	60045	80649	35179	03185	57068
72622	55513	82844	85553	16852	57931	84063	57516	46529	47030
63755	08166	33097	46244	16769	48531	56618	90035	88363	04097
23931	55916	48477	33067	76572	84835	96208	68558	23560	89245
96443	13697	61186	63971	20547	14846	77137	62636	88927	34322
33595	83707	92545	83866	06895	28019	08547	04275	79277	28833
87400	72301	05172	25637	13665	86725	45970	42670	35291	22685
10716	35521	73850	99275	97475	11064	93492	05362	57562	99582
81465	80905	77978	42899	65518	48688	96755	83554	76916	15224
77706	53575	16463	00350	44697	94868	22697	33740	60701	04034
75622	35864	56564	40277	66044	78417	52968	52982	82340	92970
18418	16826	26355	51841	01235	15986	65898	74181	51391	11313
02205	51273	87582	80276	88583	30633	50721	65017	48735	04476
08345	03180	15659	86285	09579	07969	17850	88197	14309	25013
43734	89733	87697	28098	70926	22790	79293	01093	72673	60257
89981	80872	87829	56857	78208	85949	60249	30159	45499	29735
20660	70109	01273	42633	77445	02439	03144	12100	12971	59574
48210	18773	36169	60470	37941	68015	76627	38973	81699	34262
65433	21735	36444	40569	32023	60078	31045	99679	76253	81056
09638	39323	55045	58988	30967	16461	57491	58625	14327	19825
89418	30419	67738	14877	17948	30083	54764	62024	68310	21207
23083	08913	59531	11403	96757	23468	57382	48057	70725	59933
30343	01516	78510	15138	49538	58588	06080	23844	44412	87882
18284	64484	57502	80120	95894	34977	74098	73551	81743	58364
47943	40974	82162	34485	44930	27794	66180	76055	69035	91186
55480	50090	91328	09979	23824	71199	65640	69121	12071	46595
29905	46328	06091	12419	35540	09817	63102	80393	76848	09779
82268	73981	37205	65249	07751	92537	92368	09251	29892	53919
42183	74789	78645	68686	12399	27592	36651	05904	45764	11336
82178	50120	06396	62927	27126	40350	87365	28918	39266	22549
49836	15424	10577	89926	89407	37622	38430	48356	93062	86591
96881	32775	85851	60822	08530	83330	99819	24740	34199	90176
20414	02812	65040	27108	34291	90243	18207	85800	53786	28723
62174	64315	82589	31761	26476	95984	54304	13061	77554	92988
48808	13755	89592	43057	35053	58853	20086	12130	90105	26139
93162	69261	87781	82538	75030	08496	25862	41090	06267	07824
81009	59154	63054	77841	35348	61706	27750	03274	64051	62435
11796	19222	73310	68903	54526	56338	54017	47320	67925	40813
48728	67741	07718	37592	95126	68160	55907	46168	06840	96853
73347	09803	63349	39332	23487	69045	51759	99114	86318	60963
34704	15020	45067	29373	24970	94427	23023	88559	65920	94063
24147	47285	01070	86152	20380	13113	60138	69612	38184	41601
38113	53850	17580	01850	33698	60239	84065	82019	52464	11886
01435	59660	45587	96635	57407	97292	15584	05498	54391	33149
76230	93764	38424	43810	11252	02843	64856	71551	66186	36921
76698	49005	35125	73104	93675	83189	38168	69103	75653	64780
21081	41735	47975	16487	37540	89936	16311	78716	51188	87349
25671	32206	93142	93930	57886	14113	18177	97474	32669	21337
03245	76312	63143	57914	10925	61894	91043	64156	61020	55339

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12304	04213	03857	77012	84959	53863	21679	49848	20212	95997
59502	54256	54169	18949	00578	72749	86070	61699	19657	21066
52525	24721	81450	99816	07524	29159	99127	49280	66476	22569
06066	38128	36539	68551	74800	30921	23803	32781	20508	10456
31362	41206	88773	78930	14709	25123	82601	48698	86804	39779
55291	39114	43274	08119	42433	53045	29083	18310	02445	83490
51077	99516	90497	26100	79144	28324	78290	22654	79424	93171
29369	93401	32750	04395	63773	29493	73060	05438	78848	21222
42533	89580	38883	55304	05990	22509	58052	94655	59881	73803
04754	07817	51857	38035	00758	84795	46887	37543	12070	01151
32520	68082	07089	28568	15498	00217	74945	29306	71156	07467
18689	25625	09537	43720	39550	47209	02896	40180	52349	02624
57766	90922	46815	02604	10651	47538	30491	39659	19233	00997
16644	40236	98798	16895	47562	30781	89366	72890	83027	49302
54973	61336	84051	15680	61130	44605	42552	09081	57256	55053
18843	01926	08340	63318	39291	68949	86588	81732	61205	98340
30789	48386	59732	94241	28859	07370	25804	52349	20145	54183
23835	05112	17169	92771	81220	68367	14568	66179	63268	15912
99348	87514	12386	12568	79923	56581	59255	48255	03675	88717
52403	25537	61636	84602	75830	34897	64019	80421	94358	83868
94954	12924	25669	91119	51663	92889	25249	10664	31461	37253
28337	02935	11644	94210	85920	78117	31536	38256	97799	78542
02045	59831	38770	48734	87524	74387	85480	33475	43352	00890
39668	61855	36871	50775	30592	57143	17381	68856	25853	35041
77174	97729	23913	48357	63308	16090	51690	54607	72407	55538
84205	12639	79348	36085	27973	65157	07456	22255	25626	57054
31893	11224	92074	54641	53673	54421	18130	60103	69593	49464
82986	90226	06873	21440	75593	41373	49502	17972	82578	16364
06252	31044	12478	37622	99659	31065	83613	69889	58869	29571
39097	59195	57175	55564	65411	42547	70457	03426	72937	83792
54053	73645	91616	11075	80103	07831	59309	13276	26710	73000
92640	43265	78025	73539	14621	39044	47450	03197	12787	47709
95234	80109	27587	67228	80145	10175	12822	86687	65530	49325
48122	50637	16690	20427	04251	64477	73709	73945	92396	68263
89174	38509	70183	58065	65489	31833	82093	16747	10386	59293
16862	18929	90730	35365	15679	99742	50866	78028	75573	67257
76054	03096	10934	93242	13431	24590	02770	48582	00906	58595
39901	38669	82462	30166	79613	47416	13389	80268	05085	96666
39221	64403	27463	10433	07606	16285	93699	60912	94532	95632
14704	78488	02979	52997	09079	92709	90110	47506	53693	49892
35052	59679	46888	69929	75233	52507	32097	37594	10067	67327
01514	33319	53638	83161	08289	12639	08141	12640	28437	09268
59723	91330	82433	61427	17239	89160	19666	08814	37841	12847
75249	58952	35766	31672	50082	22795	66948	65581	84393	15890
82558	71239	10853	42581	08792	13257	61973	24450	52351	16602
80822	66731	20341	27398	72906	63955	17276	10646	74692	48438
41067	39859	54458	90542	77563	51839	52901	53355	83281	19177
13008	65442	26337	66530	16687	35179	46560	00123	44546	79896
36084	99076	34314	23729	85264	05575	96855	23820	11091	79821
37741	50156	28603	10708	68933	34189	92166	15181	66628	58599

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00958	98267	66194	28926	99547	16625	45515	67953	12108	57846
30346	26957	78240	43195	24837	32511	70880	22070	52622	61881
14056	57841	00833	88000	67299	68215	11274	55624	32991	17436
96789	22551	12111	86683	61270	58036	64192	90611	15145	01748
12633	15075	47189	99951	05755	03834	43782	90599	40282	51417
25893	57092	76396	72486	62423	27618	84184	78922	73561	52818
13092	50817	46409	17469	32483	09083	76175	19985	26309	91536
72872	54109	74626	22111	87286	46772	42243	68046	44250	42439
20724	19944	34450	81974	93723	49023	58432	67083	36876	93391
37009	52173	36327	72135	33005	28701	34710	49359	50693	89311
25961	70386	74185	77536	84825	09934	99103	09325	67389	45869
73962	47022	12296	41623	62873	37943	25584	09609	63360	47270
63164	76372	90822	60280	88925	99610	42772	60561	76873	04117
05366	00082	72121	79152	96591	90305	10189	79778	68016	13747
15902	61363	95268	41377	25684	08151	61816	58555	54305	86189
53845	17851	92603	09091	75884	93424	72586	88903	30061	14457
31694	55633	18813	90291	05275	01223	79607	95426	34900	09778
23016	96567	38840	26903	28624	67157	51986	42865	14508	49315
17292	18430	05959	33836	53758	16562	41081	38012	41230	20528
75465	99837	85141	21155	99212	32685	51403	31926	69813	58781
89013	86492	75047	59643	31074	38172	03718	32119	69506	67143
44551	77837	30752	95260	68032	62871	58781	34143	68790	69766
49675	13139	22986	82575	42187	62295	84295	30634	66562	31442
40789	73539	99439	86692	90348	66036	48399	73451	26698	39437
64086	82765	20389	93029	11881	71685	65452	89047	63669	02656
79143	31528	39249	05173	68256	36359	20250	68686	05947	09335
28231	07703	96777	33605	29481	20063	09398	01843	35139	61344
76327	50155	04860	32918	10798	50492	52655	33359	94713	28393
05428	65225	64285	86579	77447	75313	35762	45824	21535	48707
56800	69853	75583	38682	55733	98453	35129	73541	62087	36549
96180	50261	88659	11717	88909	87891	16709	97814	26600	79266
52712	95148	66393	07111	89741	03758	42184	67000	66680	61277
76869	19027	12764	32712	60671	98845	81227	38052	48243	91867
50472	24399	17313	79665	07409	73900	66673	58861	08168	10289
77168	64382	26927	54318	51043	03483	76777	27319	78196	16909
79482	10156	87785	49603	85048	63090	60719	29756	10696	75713
97826	82559	69027	41569	05422	47286	97825	15559	43482	07676
00872	36839	01840	14860	76529	55890	12228	33910	26878	88758
68457	71054	94300	18582	55813	26346	68685	24920	36374	87702
35973	75910	16921	48284	48074	01401	10518	25359	52702	82966
32091	50229	65799	13777	93030	53615	17057	07212	75930	56604
81440	18180	68025	89261	65881	32138	73735	78459	74164	18466
83893	89983	95140	40089	21441	39173	46895	16136	92301	33754
64000	19357	74288	60608	49826	78374	72191	94337	24234	44821
48420	68527	28646	44721	81925	48579	35499	63475	95235	51410
96237	34204	08890	41795	28507	83735	82390	49173	80738	89279
13429	41773	59936	30327	76898	96866	22721	96619	20297	01714
20753	53940	49246	73092	81744	00189	60064	57631	77199	82742
63752	93547	77926	16709	05242	91269	52190	47481	82784	61238
44416	49199	55899	09790	70636	19057	51986	69657	97293	47729

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57278	28133	04340	19889	27266	77468	02509	27534	00342	30727
97953	43227	41110	86887	19559	64945	54520	90528	18850	43610
07431	45121	73187	80431	57245	77311	44596	23531	63637	47042
20930	54735	95568	86799	49721	89049	01791	81084	03284	24096
78003	86322	23893	19483	18624	78634	31967	06395	34924	67283
48541	02641	89681	97881	69919	24170	85386	25834	75946	90965
52684	87995	43702	10623	95580	75795	59360	87848	83250	44168
44032	67360	54462	31774	01629	03406	81878	92801	27984	89892
40757	07266	13231	93527	51509	19550	24785	11136	35905	44879
42290	21749	34505	46547	03354	83574	17762	07646	66469	61568
37592	08604	53542	99986	26017	84967	86696	19155	88259	03612
32583	59967	64315	84822	74950	80322	10037	19425	96714	97330
75625	48032	05891	58701	91532	81253	87706	42235	44799	58271
91808	34409	59390	38399	09462	07373	19799	04132	31531	16485
11926	91034	26756	37752	47276	70856	94741	55372	50250	48775
78782	17338	68884	04609	03479	59241	39569	13351	64340	34108
54319	43047	73502	30408	94554	18640	91396	16242	96184	64191
34359	78839	55454	08551	19021	56584	84609	26286	31079	89061
52871	79550	40787	87299	70144	45090	45199	80127	21304	88681
69226	39419	66757	59927	04968	56061	66103	59708	36607	79140
07575	58710	92577	67823	52832	36514	56137	11321	62025	09049
91682	48619	15333	05876	20802	39128	75562	10170	72858	07010
62040	64062	70625	57559	46143	46638	37861	12551	58076	87218
80099	81346	54688	70326	22662	08106	82354	94331	29618	38043
77758	41609	69027	03208	28505	06689	61270	67122	45496	30345
20009	11788	77442	46535	09576	24905	46353	63277	36064	58249
52091	84347	27681	24853	68826	04138	83340	96698	89529	46622
19569	02594	04226	93412	36370	16393	05509	43349	01135	99264
48286	19309	39931	61597	95916	59340	30322	56291	45847	85836
44400	82261	21889	89837	64397	05508	31365	36334	08765	89749
19322	99470	86311	96458	84173	06386	39946	49558	80223	69513
21704	81386	35499	57991	05992	47982	01949	50203	45471	18610
59506	33660	80198	19429	26262	42605	64807	29526	50672	49761
69876	11749	18876	54051	71446	40239	42174	14601	61255	24318
47268	55681	53952	54010	24425	21284	90929	05499	37739	88835
80651	73964	85491	79648	30293	31305	96030	25760	85013	03763
91894	81410	81245	09998	80494	86183	01343	82296	80842	58427
40239	16519	23159	32970	91162	40386	81829	16582	45640	07032
88212	51975	93468	83446	94238	48988	63226	05278	32797	27430
55103	14461	92774	26397	46587	51470	41598	29070	26690	69567
15360	93359	86173	53747	03141	75425	69947	37198	30936	99987
70678	38035	89688	64524	08530	87826	82214	05660	04461	28460
23620	33295	98309	16475	26722	92523	62702	02103	38482	28012
71594	59029	79559	67497	56559	05538	38354	61813	04816	66451
63723	62966	40545	65085	77086	03427	62353	77932	81281	32626
24852	88450	99212	80393	72573	59370	75741	05229	43644	29794
80184	48999	76580	84648	04210	76599	43704	21301	06957	66554
46973	78646	73852	44752	50849	07905	65120	48320	23223	96491
18043	96840	23148	89768	10865	45987	55568	08478	73137	03867
84956	48341	26773	23897	70640	75961	04522	09761	81718	63357

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83183	15461	88997	96634	39343	76187	51649	69036	04387	43933
86561	67600	87081	76544	08982	44799	33555	05868	05527	41848
27512	89046	61975	79250	64579	21693	78499	77459	73214	50062
61330	11838	37496	74484	83272	89275	10818	38111	87939	44211
45991	21942	34406	28785	41740	84445	77205	84394	40760	73845
17361	67790	10353	36885	34317	44264	62994	23179	86523	35982
11364	46345	40639	19572	34159	12518	86926	65650	14931	57011
13487	32387	76475	72583	57269	02420	57224	07061	28379	21115
17471	44765	26548	66533	61231	65829	31960	22771	61051	03459
23375	29913	24245	78402	03791	21882	77019	79658	47396	86300
79409	54902	27283	19483	87369	81683	54726	46546	95474	54716
40624	97378	15645	87183	08818	44776	41489	12313	88860	09769
47740	49996	90997	40690	73062	99417	84362	36977	56369	33825
76063	24841	77021	90894	16615	13830	51094	31691	97311	47805
85552	39430	08275	29116	76537	95406	02098	86244	47511	92035
73400	98752	94428	82470	70234	73327	08371	99302	13947	18310
41227	45475	89941	82220	08842	19485	79705	80566	50682	96893
66320	30514	47330	42274	93579	79302	54240	24684	30781	01110
00073	79317	11694	06965	89006	94316	48751	43521	95198	95046
19931	62537	55575	41981	08748	11998	42525	51396	77505	85222
87074	08966	20423	48407	68906	90485	99587	62608	73296	11785
74563	92361	75481	22882	22919	01961	57961	65696	97895	34882
33982	03375	06982	00338	60557	16906	95057	64678	84564	58282
95867	32783	17767	06580	69379	21304	54385	57337	66048	41470
09816	65864	15555	43592	80089	40820	92984	23197	14041	50563
13779	17566	55197	55767	30887	28696	06354	94094	43299	10142
96515	24730	14411	98243	03526	00286	94458	84907	43064	89119
06581	66943	72967	97927	81196	15864	14293	68163	50903	35519
78198	10415	16231	82188	84332	40420	93463	00800	72462	56395
72217	51940	16252	86297	68166	83136	84292	30992	22657	93321
36602	57329	94716	80613	52102	02741	25523	50508	03878	62175
35220	00526	97050	74475	93497	39667	48890	38895	43131	11725
37659	02508	02161	82227	82576	00971	96152	59703	45999	66196
06123	81274	09518	38568	99416	66646	19522	92783	06648	37495
32472	45765	64687	06419	90828	54913	04257	20390	70620	34744
41937	54184	53475	57677	92683	77875	53562	73074	68772	17265
64203	17781	64522	40751	98591	63881	77361	50224	90595	94544
54748	28150	09088	95562	66008	41668	61055	12113	41145	33638
89617	19797	18631	16868	32211	97243	07806	86319	56303	25722
63114	46266	86924	42113	16959	35570	07168	74833	90074	40452
48797	96322	89434	67288	17497	11072	03346	07911	13655	47458
94761	68684	54663	56219	14889	90785	42384	79738	90052	02784
22523	08100	38128	66588	06899	61628	56409	32917	81762	33800
77245	32835	57649	06567	40270	86475	00593	52298	73492	48076
94958	53811	06706	05420	43164	20010	55845	23310	24208	17860
64716	84933	35061	22454	65854	62172	19370	08400	77516	80402
18339	99156	94403	32952	27225	48489	42531	46612	62830	18599
82150	89664	56067	07766	90242	77855	53638	48039	14134	68254
71143	09316	84551	48576	04613	17628	05044	83303	38751	74867
00944	53807	43766	59023	77152	34989	00924	75152	03837	81996

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57516	33747	06831	96252	31779	10830	69091	08241	98420	89517
39268	60588	27898	69882	64019	03284	50134	04387	46535	32736
75711	82466	24904	58171	13871	59513	35837	46135	70004	46840
48817	14059	89377	19670	05642	83284	22117	98269	10607	19187
08090	69146	68347	94073	69418	28633	74369	67856	89800	35908
23561	85971	37362	10657	30353	70564	17859	34684	45661	08168
23013	91122	18394	69196	27019	79767	91568	01829	29434	82946
17388	59294	21118	87103	28468	51339	40972	81840	34466	81721
78371	28385	72092	71887	49109	92668	77129	07083	97824	08008
65182	72610	38508	96133	90349	86078	10011	23017	14121	27827
55368	14100	57714	36082	10900	20721	60285	61376	70801	42474
32794	67872	24227	40195	61483	16991	23910	31528	97545	02971
93934	48600	76694	01622	57474	87900	34055	05896	50650	90034
33249	37997	95991	63797	39089	36203	25421	78775	44706	45433
93142	22835	73003	10659	78861	90887	57965	02598	75896	77513
54096	83219	64260	62543	03437	60288	68706	14510	90539	01072
86772	63897	16313	30365	60525	78336	76362	99969	74452	40354
34028	97995	33534	06819	83492	66904	16966	44818	85952	45129
99224	17222	62766	26166	54482	55713	20898	28709	70042	46466
48806	36559	28718	52823	99285	59135	39405	48174	59856	05918
96947	64653	47928	25269	42939	14792	16077	92751	11545	83261
64208	04451	98807	63587	50222	53976	36325	28225	33873	54328
42406	33938	82822	81613	05879	88394	50918	28786	66090	51554
17682	89917	69167	21525	04531	41654	38625	97558	70167	96943
05984	30315	05185	07689	28325	42983	43613	52850	78155	32843
81910	01465	48825	56146	39554	52239	09311	01939	05749	45215
39518	98704	05209	57436	33376	93929	20810	03834	28747	31626
24524	30021	29832	70231	96077	79507	49340	47646	08538	69998
07701	33187	24591	35234	08884	10487	48859	24720	49469	89057
92150	05739	57410	03567	24486	49071	64766	71131	94851	11508
67765	74112	44661	51925	04791	83512	99167	88659	33617	30832
22564	50040	81638	15428	41173	14877	79072	26097	48719	25670
05855	02164	74386	26018	79774	99563	73684	70620	26498	21037
00234	25133	07565	49325	12328	33723	91221	24353	60670	35342
98118	71680	04099	57757	88140	07208	76309	48330	91264	77936
39302	64683	95388	20259	20924	88534	34087	90000	07900	73540
02982	13503	28033	50836	66941	26823	44999	40571	19446	74690
53872	27988	77575	71142	35977	52543	13091	27754	88593	82162
29658	00175	67827	88394	04665	76107	50790	60307	85075	39935
58387	81275	92390	37895	11137	64692	01908	12630	16171	18874
04755	78939	34888	84796	72315	04347	78733	43658	95853	77314
38916	03129	90039	33356	62300	57453	13940	45965	61549	36957
76087	79901	49755	33329	45412	31415	43951	55925	36356	44826
82251	11028	82521	02331	11273	57294	26579	38440	51046	03887
98250	26658	63587	88638	82529	62334	82773	03684	26806	53635
38852	56056	91833	78352	44200	12426	48964	62341	53454	05451
15651	92455	37352	64350	09494	70331	69104	36612	46798	40145
50467	46033	44649	12306	06171	39750	66480	80649	02547	22140
76233	62364	28025	12444	52077	27402	92194	15167	99322	87689
07000	64530	09973	35046	11135	14382	90667	23626	72881	40503

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40681	27353	22597	88915	79178	81568	96319	51098	71270	63812
89713	63020	45133	71152	54318	33657	45481	41509	04687	33262
94563	84957	44619	79713	09949	65244	53466	55985	27077	81993
43027	68321	02813	47446	08517	28803	96663	86674	67775	55543
51194	79763	80567	62318	21541	41301	24034	29986	79315	61613
67373	65291	63392	50049	64763	77384	69945	86642	49238	31727
13011	44976	94731	44841	58114	02487	68308	63610	64436	79719
75053	10760	56728	67907	73573	06858	89809	12729	13637	70054
00416	07842	61398	82483	92684	53713	96476	13096	08892	29976
08104	19067	07653	11476	57271	28172	20924	86795	80075	74483
03614	04739	91340	60151	25949	13799	24239	37699	61160	65534
51781	71407	97071	01707	52119	71110	83590	08030	00655	26829
74840	30355	24811	91014	44450	53425	76329	88396	25471	24939
17855	86540	13831	52245	61860	99428	74067	55408	52533	50065
01207	28820	12109	62958	47884	88218	55819	09726	67161	38420
29475	55575	37654	91091	33918	95562	68096	03709	34564	53896
87008	92552	81623	12154	48696	96053	47245	69520	09495	97197
24644	01087	32311	77807	56658	93684	33336	01512	39831	85626
46326	03892	41967	94372	32998	58406	24326	88509	63328	21618
35039	82275	32560	11945	50878	87600	66917	92413	00939	75858
51940	44169	83459	88888	07752	23211	26260	08693	29368	99956
65375	34741	99245	09156	82529	61952	83897	09931	76427	69486
93919	72535	35297	38351	69774	61954	52808	51707	61318	15122
32641	23240	37301	36135	25186	02274	25956	08937	31372	06943
40131	51356	32702	75474	84559	53684	28758	39890	72112	15426
65093	45655	00947	97180	35175	46277	19665	24873	75652	72660
91020	86594	87835	53859	50205	22739	94579	69359	17526	57074
89051	71343	26912	15341	31812	05179	17404	23642	30470	35331
66627	47292	87259	27395	34567	98159	40764	95925	13833	63765
07313	43774	88701	56132	36069	16027	05491	37788	27276	57333
13840	83975	89909	88547	08856	37066	42128	07117	10909	68721
56422	38011	10458	65809	15295	99155	01271	36612	93163	18865
75812	82841	99809	33958	03468	98967	60237	86604	34209	87042
78396	28235	26532	83318	77096	36217	99285	32993	85093	53164
77050	98159	56449	08000	65445	38130	72304	32656	58223	09472
45534	45029	84611	04753	49955	10020	56276	90596	89037	18424
97612	39593	89037	03471	76022	08527	21418	56626	24739	06594
95835	42224	66513	35514	19282	86647	84339	33670	50372	38939
34916	94718	93210	03218	92353	34164	55546	57339	89379	94890
46632	41268	35295	93493	61016	32761	10767	22685	50950	78485
01487	64386	02269	15196	93712	61311	10786	18485	81751	28908
44214	71437	59039	12657	80005	17106	78682	91223	82971	78688
90468	99815	78139	69224	02220	59965	69932	79094	04080	66786
74232	24251	70330	91262	09355	68912	96661	67153	13462	29941
92253	94384	36540	11770	76555	77366	83318	75211	83624	32330
53662	22108	08697	50312	91726	37906	10009	28915	25505	75795
15458	76661	02770	47195	68630	08611	30428	16774	55857	73460
53020	68646	01282	42227	39343	72195	32849	66381	88405	87540
28256	03411	92796	77002	07332	05353	45197	37779	89154	38303
87490	35299	62241	27197	04170	36179	59465	39318	01340	85298

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77365	84989	17521	86996	40216	38060	22038	50035	54179	99247
98564	09578	08118	11418	42906	78422	47268	88311	82475	95915
37171	91202	13275	49335	22201	62982	63361	20829	66849	36574
00487	70218	83995	05943	43636	75253	22841	62327	24613	64369
83115	05326	40730	17580	37854	63229	91647	92765	92632	23253
79092	71196	44676	33512	01394	11927	22321	90070	38307	99723
86555	33377	40446	57482	58101	26629	12257	00015	53614	32100
93351	85950	99349	11620	62284	33313	93210	92284	93675	88780
77773	19056	25171	18153	59858	13337	70529	67141	76775	39334
76172	13078	84800	47831	82640	02881	18501	15704	93947	66994
91260	90776	06058	42048	48396	82962	69114	75762	94297	98514
89420	52217	44050	86788	46110	71987	95231	96141	15210	36768
08916	58309	95173	47126	66805	81178	63576	01825	18772	54169
63352	95840	49426	31106	26577	40801	67358	37237	04742	30815
02415	34941	23716	59285	75770	06360	49221	97070	20811	93055
34367	38621	74880	85545	47343	02245	62915	46770	76906	30021
35893	44454	79677	08449	12614	21128	37971	99205	27334	50597
23779	16329	55800	02894	85378	78085	61601	85516	80368	16427
27758	86488	00731	24755	13278	87658	93411	61897	23215	43797
26314	47193	73823	63567	62403	53768	83621	16593	81942	19120
84758	66959	40133	78418	60601	57108	44953	55535	47182	76583
88548	80290	36501	07586	31538	62513	46903	05660	59653	95970
88657	43247	42762	39627	73595	60282	53768	72987	59165	93598
96504	29518	41121	27162	41884	38587	37312	11860	32383	28128
69659	67267	11682	64014	16865	08293	64331	61993	86565	47534
24976	56101	61342	33229	84141	71359	04153	29544	73101	27893
49443	25755	35350	82605	09294	27207	90180	61397	21835	03109
43174	84438	58429	55588	18290	77373	47873	41884	81234	06291
15378	84917	59806	93088	43400	17930	30694	05331	93144	39782
02761	77455	10139	41627	92800	83302	32455	27882	21304	98277
99323	87911	42880	08801	91694	93650	38343	64739	03637	12498
68112	17668	69472	43554	66423	37308	20955	58759	44993	01751
52709	33577	43011	55471	96838	86833	20257	84274	12632	77578
28178	81438	03102	37690	44973	46333	37079	81345	47852	40187
23042	05483	65965	03410	22330	00437	77864	75060	03518	14869
94292	75630	73995	08657	04090	67839	36670	42546	47662	85563
44200	88766	51670	30853	70096	09340	60882	56796	39238	82325
41949	26318	85345	82316	47684	11315	17236	11016	77153	39994
77096	45556	98245	41062	45512	50660	39978	68138	66138	55839
64554	70172	95784	94559	56008	13110	54077	63713	83761	29785
77870	10750	59312	20509	84899	63090	78224	59536	85265	47072
84475	42203	41706	78431	51870	47386	20719	40068	47075	07306
28460	69216	62943	82915	46264	05619	74543	75570	15802	87269
39485	15469	00253	81603	64997	55681	95636	07712	25046	11466
75513	78863	31109	00306	86477	05800	78575	44646	04731	73909
35914	77883	12256	14994	95956	64968	79781	69739	59711	25704
02840	55140	50096	81588	30186	46222	12502	74890	63559	99159
34617	36056	99441	20370	76848	72598	26487	84515	61891	84437
70620	16369	93716	18983	66488	48841	20819	75031	52307	05976
70445	63247	35139	47988	28156	04077	63015	04896	13605	34246

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61721	03748	38841	69166	01752	51219	78247	70734	10493	25093
98963	01854	20841	52865	31500	09283	07363	71612	77927	61691
23932	43062	33464	15924	24387	75728	31074	53262	70995	42071
15671	70400	88477	85686	91199	11089	56188	53946	30159	59284
73782	89043	22541	79933	57728	87000	97222	97795	16128	55709
83102	95333	74207	71472	52329	37785	52626	28600	13567	45016
46384	82071	00261	22133	43136	74270	98330	82464	44016	03638
58386	47279	85564	56751	02884	47595	53203	37306	69859	22351
31677	34913	92024	95851	73195	55542	52537	17487	95617	64009
90341	27029	35388	10015	54091	25240	28945	51638	55394	00151
53694	56321	51780	85766	24303	91130	08054	93015	83580	78969
14321	34850	57577	81552	88279	30410	36607	00387	97499	10178
05124	43526	80602	08431	39622	90293	58612	37471	28521	98765
04292	67049	37226	77648	62162	92421	33333	76923	38256	78580
09273	84395	97382	42955	25730	55790	91405	34801	64616	44550
15183	69840	80256	57175	06706	71873	79425	03789	29375	04018
88721	47483	15683	85491	46116	03661	47229	63104	29262	61523
43140	44368	16104	46863	53687	53452	78524	02933	56326	83043
91908	49963	85656	41706	18596	42334	71506	69013	64856	48793
96335	20856	03851	47753	99980	24449	39005	58497	03063	68636
87866	14100	55056	01560	58002	26742	43174	30123	39842	37466
78236	79903	57595	30611	49302	87218	77848	38069	70385	36871
36780	08641	20571	13793	09612	27066	20227	50363	44940	38920
18366	06852	71154	94608	70392	04956	21448	09296	19038	61598
45576	91644	74141	23815	82267	28271	81891	31523	20613	46854
89567	21054	47503	25472	75618	13071	81465	31184	23883	03637
23892	65090	87940	33934	31962	59572	77446	83552	31265	38746
31487	44209	43610	01733	05897	66428	34733	44085	58254	37004
46686	41250	54473	98489	59263	22269	45986	60634	51370	17736
71833	75595	31885	08056	46018	99133	90402	28771	43275	34353
72439	98123	65087	40454	51519	56816	30889	15487	81497	75570
77297	37843	69199	76739	18081	58820	85890	87243	84176	35053
33099	33358	55914	34239	47499	14384	13438	39943	86175	28198
95151	61859	09679	83413	91905	36927	18890	57426	28948	02750
74862	50549	49476	62215	87910	43389	28230	64566	36542	10223
10078	82651	08775	29037	36499	33125	98741	71329	21150	07281
56261	21774	62041	84210	04967	23023	88794	40799	96828	01518
06678	84070	69595	48871	86757	92546	81373	54006	67649	56869
34845	41877	95482	84017	32677	11746	69577	07078	12507	58072
80515	53345	11650	03594	64422	97801	26586	82586	54104	26852
32368	38947	68635	82913	60872	11703	40814	67598	28132	64838
80379	42553	16780	91837	61799	70339	45738	71862	56776	15540
72433	90816	97471	61115	17983	26639	45691	24106	42228	00493
87540	87245	61508	31508	36613	00978	03175	34398	14783	88859
92059	84967	49256	33531	79632	66030	15062	01204	23499	32555
12060	41495	77722	23111	04569	70487	87652	27892	93641	51367
39434	85821	57004	00302	24395	67592	50929	27203	56495	44117
49351	81841	20972	12359	52778	14954	28085	90846	75750	72350
87831	38461	72475	26174	54460	45191	88378	78906	57966	61603
25764	17666	45682	74833	92963	48400	13993	70089	69582	82222

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26437	80025	68310	83961	94972	15323	72315	71272	28132	54926
69541	94346	81840	32370	25073	32979	45546	37772	75378	11422
51989	15674	90358	34235	61877	47304	69369	41499	12442	88491
65898	34643	46340	07789	14195	77031	94179	76270	46504	04596
61946	15619	41994	19126	79120	28489	13988	02027	30324	97010
26191	58514	42860	57235	13474	07138	13510	41715	08805	00892
32411	39136	58948	60268	99980	17465	42040	49687	31346	42819
64051	48551	64819	31103	49883	62627	81967	38604	68547	96808
47127	02361	38690	70982	29182	55610	49353	56290	60863	64983
39329	05966	85612	37608	56042	38353	37995	59683	00731	18332
42828	19215	93119	74749	01231	43201	64648	15674	91649	11914
80874	41559	70657	00870	33446	43475	14629	31571	80282	89053
90700	42746	17453	07672	63371	01001	89043	83404	07292	13587
22966	26175	15085	40523	28129	18961	59020	34377	10435	11318
23185	09653	59384	54389	40749	20996	17178	64876	78199	93162
19215	35070	48941	81116	75687	39424	98603	35416	80076	50499
73472	47371	80840	87165	01834	64836	85357	16813	04063	35411
52175	00848	56107	33893	95933	78114	71504	44275	28933	17598
86051	97054	19618	14530	89367	44812	67239	81440	83040	22263
27156	24240	12949	53482	82244	56538	00025	57788	49861	26344
87998	56428	79586	36404	01007	80414	81540	93191	81564	14721
85669	46650	58994	33647	46647	95550	95293	35374	00024	03356
72948	48729	73049	80584	47339	61586	31920	94022	13529	44566
21540	36102	51421	11801	11312	91129	05602	96582	58783	33707
10561	63356	51047	34639	09604	61804	61413	55300	83284	28188
74956	08278	00668	48373	85984	69808	04818	44925	83510	31342
65867	59252	81216	25148	56346	20317	06429	04568	08591	54958
82246	24061	78800	42684	94864	13041	27643	65513	73024	19866
43654	12830	16350	56222	94856	41992	73954	19394	36346	99028
73611	86402	78501	21602	96956	51555	18508	31283	56948	64203
52567	15912	21393	69577	76935	28055	93910	80495	48749	74114
50320	89614	49467	38904	31027	94219	94105	58822	03309	94930
03104	14551	42975	40220	48905	85275	35319	46262	04313	64939
58228	39598	51245	66151	59983	41788	61760	11584	78088	10077
66624	52596	31664	89494	30520	71663	52906	79316	57414	97817
59329	92875	19662	94247	27551	93414	99318	36369	85615	01150
27090	08032	58956	52673	42640	42215	63610	37716	47706	33887
43337	88990	66282	52586	98011	47748	14571	55132	98953	01724
64398	88518	37040	85102	15091	31282	81875	82755	65581	88838
24318	18295	38575	53256	87648	18675	68553	86497	83240	86151
58004	95558	76439	94755	27424	92032	24447	86028	58404	23965
55007	48908	54214	58152	73361	68394	83714	71766	11334	18851
30257	96593	06269	70026	97970	93436	82123	06026	98997	19558
69056	32439	09380	93591	30233	22169	72085	88986	24298	80625
72705	98991	08381	34348	01119	64586	81159	69887	78278	74752
87729	35885	64989	89065	34309	99902	44016	00553	16017	96010
70255	49084	73091	12425	40711	21218	35389	49504	44067	28793
89559	81801	83568	98061	73902	76354	39879	14777	64156	17614
43423	81125	64492	96563	18382	09479	68388	01048	72345	42563
66858	41507	53732	93995	68111	55100	64316	39013	32661	14126

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23930	04508	62244	35048	50242	67999	31536	25407	71989	45433
76128	69326	37504	75663	63223	43107	70135	10378	25207	30192
66520	29819	17478	56335	99276	92993	88457	18868	31188	41704
50626	20047	80318	92908	49020	16209	54947	20890	60384	32642
00692	11580	38646	09263	76877	05817	36856	13889	39609	55619
09979	34936	58781	30207	03578	22544	97243	55121	47763	61195
35083	82010	24906	04993	46431	41556	02842	16480	44772	65857
56834	11647	47412	10572	55006	78730	58522	66328	42258	91830
37013	23432	90997	73642	14550	51046	53319	51538	33494	74826
19205	64255	10816	06173	56554	41501	47109	14426	28435	57887
23344	07507	96976	48154	34808	28032	15431	28988	76876	45657
67901	03113	19937	54883	25893	91665	36071	66144	39757	97250
61769	41018	13717	67506	32708	34848	65378	43245	87766	56871
77088	87453	04413	30695	69255	20314	23215	99511	84106	59064
96232	51504	53689	76181	33408	69036	07589	74822	88940	65460
13738	24068	02481	10387	29920	74600	28080	75677	70120	52635
92218	25408	54086	32515	35057	92867	31816	86812	99924	16795
94886	07353	15406	50642	92785	59257	34168	98153	28959	30017
20527	69166	80257	83628	72616	91592	85581	67641	75999	32625
48816	15453	91191	25441	48827	90870	16846	32853	57113	76232
57916	36540	48876	24557	94154	74998	21646	08100	96762	54421
51631	88447	43773	49579	42127	85113	63840	02946	26197	18268
48501	25356	64351	53802	01042	04500	41752	50272	47869	87046
77281	26539	49593	44291	30014	42832	78505	19022	48837	07545
79287	83125	22088	83259	28143	61286	87926	14350	22476	63834
35196	81343	68565	02702	36712	97281	20012	41738	86025	77694
83317	90112	93949	49559	09920	90831	75864	52587	23624	34060
93588	29091	50338	02219	97553	75374	63667	94437	83366	28182
90384	84218	25670	91824	04963	06594	70740	57504	24616	74417
00774	58476	01209	56541	64937	80996	04156	27801	70923	31497
70484	24645	50762	15430	91115	48699	09595	55122	11918	33482
36071	66109	17267	28105	63786	21373	37358	24697	56603	67418
95880	51665	89278	42437	91040	81053	79349	18214	40130	49031
89442	29442	59700	87168	14045	73824	91945	07276	35416	85776
73187	98680	81961	98681	65301	84131	60475	18786	78258	17631
13497	95157	50069	43395	87718	51044	24251	02261	81792	91891
12561	99033	53230	11211	20685	15939	93411	57389	00048	37763
94780	81716	18045	36600	82148	00724	63963	49418	12463	14246
87633	82307	51079	78530	00767	22316	71326	50810	69267	67190
94324	25247	02977	79492	35727	87555	97651	30440	98015	91648
12909	54789	99445	31740	68137	14130	40593	42443	36383	99755
25781	26751	46328	49251	70727	77363	80826	31876	06019	57262
92210	18463	27662	18257	87027	77851	15603	18574	30742	65091
84392	93948	64429	71724	41328	20478	20518	38000	44084	88870
49969	24028	18581	07574	70122	94993	63242	75960	46855	76179
97371	03322	13236	81729	94425	27380	91797	40621	00048	22858
81498	08934	00375	44786	82428	12842	30514	77783	97002	96731
44151	94920	14290	96262	49573	09113	22271	27549	87724	09543
88498	00338	26288	63688	67312	82285	02392	96123	44800	12062
43279	25288	06209	91206	74234	52353	64708	76276	40513	44461

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16143	15307	50265	76233	08046	36409	87769	39700	44162	23558
03846	93854	13457	40936	09703	09718	22800	46020	84646	79401
05481	18913	85765	73483	11991	62233	31671	70640	11517	26546
14909	88639	21584	77470	66581	44108	19740	67126	23723	69366
07291	52235	24020	95439	39620	57106	98477	29360	50462	22377
13324	85026	98436	69226	06544	73800	31358	45762	00454	23428
23411	99184	68997	75425	48601	18018	91475	04419	41441	92740
98802	50684	82295	12312	60781	08689	12095	65696	13488	97462
28060	15375	29832	71902	37012	10019	36654	65721	48462	27592
47301	25731	95695	86757	96576	28880	18521	12846	16133	56442
61764	12059	32220	76922	27086	30022	39196	44522	60531	68531
41843	36863	24696	13344	53985	84182	68559	14620	20946	97051
34437	51523	82974	62369	99430	47260	38625	72945	95553	69333
84817	89509	92780	01660	85577	17764	66912	53757	99671	84159
59605	17571	54922	33311	75864	09351	89218	76965	91485	26744
89635	61029	72451	90971	62924	24284	34634	11531	12874	06277
48096	83826	24547	82738	98562	03080	28191	34920	20068	19067
33191	88105	03651	75057	79761	69868	43959	24762	89638	33247
28362	10330	85125	41800	08578	25986	24552	26271	90431	91558
92725	44352	66605	15579	65096	75214	42124	90038	99074	11543
28601	58253	63801	49976	77579	91011	37335	53079	68790	75934
53565	80880	61494	39794	33080	99793	66299	20081	65463	30600
14142	23014	84170	89253	36367	29919	33035	98671	96636	58251
35625	08967	20656	76386	29496	77953	20616	08143	32555	23412
91469	95135	40981	32231	74311	74301	90476	45777	43715	80636
39610	00784	49950	60606	42324	89429	24015	79070	69930	66076
22675	39720	34632	11489	09422	86423	48673	03361	50734	57896
04343	03434	41010	42467	28999	21845	20251	28101	16065	30954
72636	92860	90188	95428	90558	48449	88727	00786	90574	33788
10301	65954	08799	77258	07810	20140	37852	59924	02888	60316
28438	12095	22965	33139	14569	24160	20492	39242	99794	27796
52538	68238	89072	73444	84575	74705	42750	20850	48382	09514
57042	12043	56241	84032	70442	43052	48890	34388	02735	08872
93696	55833	27957	53862	28742	25154	87392	29767	32673	97938
59275	56115	90556	41624	14841	01759	97059	49260	23410	50693
00307	76848	59984	46071	97803	02422	57169	12474	30230	51684
15150	12559	24342	07676	92101	23120	09604	37234	01601	44892
43666	41823	39934	27109	16890	86490	64789	32920	45216	59786
02334	73021	57179	07476	26154	59669	91271	31977	08111	65098
77728	21112	34408	47343	91372	33612	15480	32292	04091	70727
79880	99857	28188	29120	78933	50385	79907	01952	83105	51730
83366	17999	27584	49771	29353	33312	06852	70904	18721	38085
66957	59801	14572	37202	52985	43897	38701	32250	73246	07933
39432	17914	52773	73471	89296	99236	87597	48164	55813	74212
10322	76444	40009	54067	90786	20574	88185	13537	71910	85616
44486	13991	66374	93852	79968	78530	55120	81504	20705	15996
10932	84684	87105	06788	77313	42102	24390	72157	25382	94252
47561	37322	03015	18570	12228	04807	50568	70866	62122	98417
20176	77793	34817	84437	85348	65949	00879	50989	75404	70551
80157	94845	08468	28975	79089	88325	93917	50656	31696	77981

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22719	92549	10907	35994	63461	83659	24494	53825	97047	79069
17618	88357	52487	79816	74600	50436	88823	19806	33960	30928
25267	35973	80231	60039	50253	63457	97444	13799	35853	03149
88594	69428	66934	27705	51262	63941	77660	66418	84755	29197
60482	33679	03078	08047	39891	34068	81957	02985	83113	36981
30753	19458	02849	30366	83892	80912	91335	41703	79401	97251
60551	24788	35764	57453	06341	10178	91896	70819	46440	98356
35612	09972	98891	92625	70599	95484	34858	13499	28966	88287
43713	18448	45922	55179	18442	31186	91047	37949	76542	79361
73998	97374	66685	06639	34590	17935	79544	15475	74765	11199
14971	68806	49122	16124	61905	22047	17229	46703	39727	16753
78976	48382	25242	97656	51686	15537	73857	35398	91783	92825
37868	82946	73732	63230	85306	56988	15570	98029	42208	00190
01666	48114	95183	02628	05355	97627	74554	91267	31240	34723
56638	70054	19427	24811	37164	71641	50515	88231	99539	75745
43973	07496	17405	08966	65989	68017	56975	94080	93689	98889
05540	72301	36504	00187	90375	22891	22205	27777	84803	39220
95141	07885	94399	41145	50210	92423	13303	09621	94153	18691
75954	68499	42308	38387	52163	64563	02843	45577	93125	25294
97905	05301	98496	20682	68082	68537	70220	78282	02396	10002
23458	57782	67537	38813	00377	93873	97813	10039	25457	28716
03954	14799	63187	46191	22805	50502	08810	19572	48024	58206
52251	06804	85959	20974	73104	15009	25486	09306	24721	04187
62361	59105	39338	59358	69193	15586	57695	89518	59788	04215
54954	90337	99346	60442	90933	58323	83183	90041	44236	90815
70773	03331	84228	01405	61494	72064	24713	39851	01431	60841
68702	08331	08923	83173	67081	87472	47980	08802	95495	78745
39599	33465	96705	41458	34670	55385	25484	71068	15155	85371
54958	34935	16858	16523	54262	63310	50348	53457	39440	80411
98124	08864	36485	78766	52802	56315	43523	06513	50899	86432
43099	88373	80091	35058	35755	47556	98602	71744	70442	92312
88667	44515	80435	17140	32588	98708	93010	98590	23656	85664
87009	95736	76930	71090	27143	95229	24799	02313	17436	20273
70581	40618	16631	54178	44737	02544	81368	08078	46740	52583
03723	25551	03816	97612	99833	06779	47619	12901	60179	23780
49943	30139	07932	29267	01934	19584	13356	35803	90284	97565
71559	30728	83499	65977	37442	72526	53123	99948	59762	19952
75500	16143	79028	81790	57747	87972	54981	10079	17490	15215
59894	59543	13668	27197	51979	38403	23989	38549	82968	53300
29757	26942	08736	15184	73650	51130	59167	89866	06030	88929
87650	08162	90596	70312	84462	07653	80962	96692	07030	62470
84094	70059	86833	23531	31749	23930	04763	89322	67576	38627
92101	17194	06003	99847	12781	38729	88072	92589	61828	36504
26641	99088	65294	37138	75881	12627	19461	69536	64419	82106
04920	91233	46959	14735	15153	28306	76351	28109	86078	45234
25417	97570	91045	09929	75140	43926	90282	99088	93605	03547
98874	96989	84371	87624	74090	71983	62424	62130	44470	74725
82127	82000	84618	58572	56716	79862	59896	50702	31938	18336
26311	59516	98602	47197	31139	27631	64619	01504	77617	30219
76176	03499	17999	84361	63898	97861	63620	23931	87903	91566

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13962	70992	65172	28053	02190	83634	66012	70305	66761	88344
43905	46941	72300	11641	43548	30455	07686	31840	03261	89199
00504	48658	38051	59408	16508	82979	92002	63606	41078	86326
61274	57238	47267	35303	29066	02140	60867	39847	50968	96719
43753	21159	16239	50595	62509	61207	86816	29902	23395	72640
83503	51662	21636	68192	84294	38754	84755	34053	94582	29215
36807	71420	35804	44862	23577	79551	42003	58684	09271	68396
19110	55680	18792	41487	16614	83053	00812	16749	45347	88199
82615	86984	03290	87971	60022	35415	20852	02909	99476	45568
05621	26584	36493	63013	68181	57702	49510	75304	38724	15712
06936	37293	55875	71213	83025	46063	74665	12178	10741	58362
84981	60458	16194	92403	80951	80068	47076	23310	74899	87929
66354	88441	96191	04794	14714	64749	43097	83976	83281	72038
49602	94109	36460	62353	00721	66980	82554	90270	12312	56299
78430	72391	96973	70437	97803	78683	04670	70667	58912	21883
33331	51803	15934	75807	46561	80188	78984	29317	27971	16440
62843	84445	56652	91797	45284	25842	96246	73504	21631	81223
19528	15445	77764	33446	41204	70067	33354	70680	66664	75486
16737	01887	50934	43306	75190	86997	56561	79018	34273	25196
99389	06685	45945	62000	76228	60645	87750	46329	46544	95665
36160	38196	77705	28891	12106	56281	86222	66116	39626	06080
05505	45420	44016	79662	92069	27628	50002	32540	19848	27319
85962	19758	92795	00458	71289	05884	37963	23322	73243	98185
28763	04900	54460	22083	89279	43492	00066	40857	86568	49336
42222	40446	82240	79159	44168	38213	46839	26598	29983	67645
43626	40039	51492	36488	70280	24218	14596	04744	89336	35630
97761	43444	95895	24102	07006	71923	04800	32062	41425	66862
49275	44270	52512	03951	21651	53867	73531	70073	45542	22831
15797	75134	39856	73527	78417	36208	59510	76913	22499	68467
04497	24853	43879	07613	26400	17180	18880	66083	02196	10638
95468	87411	30647	88711	01765	57688	60665	57636	36070	37285
01420	74218	71047	14401	74537	14820	45248	78007	65911	38583
74633	40171	97092	79137	30698	97915	36305	42613	87251	75608
46662	99688	59576	04887	02310	35508	69481	30300	94047	57096
10853	10393	03013	90372	89639	65800	88532	71789	59964	50681
68583	01032	67938	29733	71176	35699	10551	15091	52947	20134
75818	78982	24258	93051	02081	83890	66944	99856	87950	13952
16395	16837	00538	57133	89398	78205	72122	99655	25294	20941
53892	15105	40963	69267	85534	00533	27130	90420	72584	84576
66009	26869	91829	65078	89616	49016	14200	97469	88307	92282
45292	93427	92326	70206	15847	14302	60043	30530	57149	08642
34033	45008	41621	79437	98743	84455	66769	94729	17975	50063
13364	09937	00535	88122	47278	90758	23542	35273	67912	97670
03343	62593	93332	09921	25306	57483	98115	33460	55304	43572
46145	24476	62507	19530	41257	97919	02290	40357	38408	50031
37703	51658	17420	30593	39637	64220	45486	03698	80220	12139
12622	98083	17689	56977	56603	93316	79858	52548	67364	72416
56043	00251	70085	28067	78135	53000	18138	40564	77086	49557
43401	35924	28308	55140	07515	53854	23023	70268	80435	24269
18053	53460	32125	81357	26935	67234	78460	47833	20498	35645

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42013	25126	49296	38839	98092	96100	44205	85129	46749	47707
66261	56987	46342	70656	04614	26422	32479	41453	82281	65793
99218	43326	71220	47549	69609	05780	01070	70739	29282	98507
60246	70506	12969	83611	57725	10209	67627	07864	05937	31892
36193	05504	57510	24880	43433	20377	33928	54749	73464	40652
00531	71458	96341	59955	54799	63186	22416	45953	94761	58992
74737	91290	58472	75246	44996	62216	27970	50154	44759	77127
53061	21680	80352	70951	15425	12816	51622	32075	85276	14589
08614	40071	68920	64920	23340	05380	28335	25114	61683	57618
96656	96439	54118	52156	52621	13824	59450	01023	11607	67538
62095	88876	35524	81750	08680	17349	89230	03916	67328	28455
77889	92840	57213	80607	03600	58153	38089	99100	73014	31305
16918	23456	81198	75611	25074	48084	03581	64703	27349	74763
46268	35453	53423	93232	96635	01540	07102	35254	17330	03758
55888	65437	40317	22775	57810	31889	32922	03784	05018	37517
25423	35242	78919	09390	37512	13982	05485	86728	34392	30716
89078	42669	29644	78077	72494	16407	04518	27476	60810	25292
13192	42580	66330	68901	44233	62951	29750	39622	68054	11176
70931	04040	92715	84711	50352	92935	37042	56655	97889	87259
77128	77829	88384	34423	38977	88885	79735	22965	69877	98333
37100	95870	34423	68405	52871	15661	85110	84313	99862	10238
10308	26146	30767	59839	47405	18099	88450	98937	72828	61186
01822	07742	73964	01142	16459	36271	07333	02936	50903	53965
07393	92846	14103	35259	30109	60824	52938	31191	27402	55803
50735	71154	23048	03035	08385	61502	23161	94518	63237	16715
07419	04879	07820	33621	56625	85884	49636	57122	98079	14220
50087	54480	86002	35638	98404	27118	02877	02755	85210	29357
71772	45715	74504	54733	80412	18241	88087	40118	06232	93326
45714	59014	12114	18042	90519	52413	93567	24945	85998	17555
59220	80301	51824	76885	85646	16102	74986	65006	53715	19746
10764	53574	99564	08495	80459	85802	76505	36292	40744	19788
17678	48295	83757	65027	35491	46418	67883	72615	65192	84193
25137	13748	72617	05969	41288	08094	72739	95361	06969	94802
73983	90100	48318	64269	19759	81850	24789	55982	30526	22676
99383	86972	98698	53377	78399	75624	77124	78996	42364	04273
81463	95646	47319	48775	93940	51645	60109	18278	29681	77883
47218	25488	68262	21410	61186	89952	11764	79953	56457	95497
81348	41579	58825	22003	49490	30865	37291	68696	04454	88205
87900	38409	86023	52902	65419	63324	88553	23217	25332	21388
55171	74690	78509	82507	74217	61944	45093	20674	95483	23757
72273	88384	07084	32642	58395	87752	57079	29525	06486	47759
31315	92691	65161	01439	80177	42240	87554	50096	89808	01816
14727	40472	08302	00582	81954	46590	43884	17637	88473	20390
83748	71311	64473	73025	90187	37261	38389	62432	31440	59825
88824	06478	50725	76185	50468	38948	23682	11328	77542	88781
15674	10172	11670	56256	01649	07564	38895	01649	51479	65397
27554	23402	41542	24214	93388	67693	29967	67477	04991	12243
37635	96312	73891	16729	11725	76610	39574	99565	36190	32008
07476	42396	95670	49941	51549	07010	53100	48997	33188	29414
66005	72644	19812	65399	48215	09132	25707	73648	60225	30702

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52534	82857	47299	48748	72888	31705	13867	62620	68513	79149
88602	31385	63436	43035	10815	07119	35964	30360	63656	60661
91400	63007	97273	32057	91951	46330	12893	86602	03710	56516
80753	34577	58421	51026	28514	06233	70431	42107	97639	90818
35885	86909	61780	30921	33258	12960	84640	11301	05409	32044
93990	99581	70584	49811	43933	14954	49446	70379	27056	95378
09614	57360	60566	71263	39899	98163	43014	09500	47266	43147
06856	28724	93988	77589	22748	32910	14649	52967	34718	90217
79287	76856	85097	14422	94957	02732	73579	31711	52065	41789
63180	07117	50802	57008	72837	88961	86536	54036	01747	59887
09472	93904	79062	09699	06683	39134	22416	66211	31214	81730
15627	05471	52308	78528	25876	82840	20825	22134	94528	53834
31677	96908	03890	21314	64503	80250	90814	92145	73283	60898
65093	27865	69792	50778	30718	32243	52658	83178	67131	95642
01874	79890	73607	21145	65168	05079	55896	97865	93480	92630
70378	46175	35976	11715	13058	69755	45829	86870	86083	32591
27728	79685	87000	81766	13756	29480	63335	37586	03953	15324
39542	43035	24562	93335	00849	57574	20158	04989	41399	84132
15083	24701	87498	56370	41122	66845	35060	75773	07576	75952
38208	12759	03955	72612	18824	70458	73336	17085	22792	20258
15282	40571	74608	54511	01418	63856	60915	16317	60816	49287
36061	06128	71126	47235	87258	98985	91898	29157	53154	15095
66755	02682	33789	88898	29899	03361	80922	66412	36269	15562
36558	16521	10515	82211	47412	59691	15381	93119	31477	83235
48090	82667	87063	61246	10231	39794	18043	04686	49861	88349
63465	99694	98810	44399	90063	42883	40735	95238	44447	54255
96395	05290	86695	34823	17766	89280	86992	56403	48722	89742
82253	29278	46716	17803	16278	67634	46388	46708	48283	64313
22288	14812	38440	61537	68293	68072	81028	50708	40678	75296
35481	12317	84403	27489	14825	68187	86422	66783	00748	81409
05628	23186	49976	51151	27859	53810	50390	21892	36258	76361
23071	52184	85989	74678	20590	84137	25824	33136	56998	20918
77886	44504	48977	07431	29133	31306	19685	45540	78390	39250
99517	36561	13069	73593	96267	34628	01825	11804	67831	49082
55302	19261	76761	17529	76210	13943	25544	59446	50749	55514
44083	43083	43603	48769	75463	96623	84077	66487	06917	78976
98302	35491	15837	75768	25722	66625	73375	40050	29995	30804
56887	14082	29531	46695	63224	79911	69596	81584	80995	33835
67921	91143	53255	79854	08527	13399	74312	58701	71350	85986
29088	87873	31377	59474	68647	31290	64092	04332	60435	15943
75682	95072	81979	08783	39007	64506	38531	09770	69281	78108
17748	60659	16166	41789	99067	79611	16400	73810	00030	39514
75168	24241	75997	82268	18396	35742	22967	65975	60427	04488
75091	41347	29533	69180	76810	13149	36522	70276	69792	30860
93673	57951	74687	75747	48063	07832	99227	52971	09475	71006
69834	52374	59616	91240	18688	84379	31381	99735	95153	94818
96128	64581	02975	98263	59500	96218	18273	30260	04603	41966
98609	81146	56638	77827	28671	58102	92651	24204	25081	50459
49501	76986	33488	89038	45521	26386	07564	31116	06500	51750
84477	65814	16334	14684	25142	48115	52182	04834	70368	69631

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77012	07384	73077	58917	90883	74805	32390	45582	23330	69756
99688	96577	36515	53327	27830	78936	03391	93326	41244	81366
20302	92144	50915	29248	36120	11778	86630	76882	41739	17986
87101	03409	76898	41137	43948	86332	51689	07086	70734	05550
81969	35233	89022	76526	43304	36463	83480	59540	47470	69287
34807	08126	85164	30912	62625	53139	16842	09266	52532	46581
80291	09797	06976	65531	94969	71925	26860	95874	35446	71293
00849	40816	97682	40753	67140	09518	54907	73276	11899	98687
34082	67803	78386	96338	90435	33261	72133	88780	99020	97004
48144	36678	28842	99910	91250	19469	81431	72494	37623	22987
71923	97743	68311	35887	84390	02619	02411	43127	51406	68460
97766	61888	77653	78082	32839	10269	29426	55488	01517	88955
18801	39524	79790	74616	77609	74732	61525	92718	25394	51080
09013	01087	80078	15951	91875	76013	13021	62817	71591	97002
13048	51611	74386	99985	44431	12773	90146	38524	22724	27506
41789	61818	51838	46690	75215	86387	93567	37939	30734	19879
58001	25588	78572	27581	72758	45851	25995	26819	21913	10179
75657	91363	06883	63767	13608	42773	63539	18529	31925	28668
59445	80665	88151	12051	63428	35053	01179	05254	68537	42581
44889	04294	07799	67874	79841	92780	71505	06464	76839	63347
81237	64397	68539	66659	52781	60654	84232	53804	65075	27220
10679	50334	11422	02765	29241	22632	91788	67316	68237	64200
58973	65467	38950	87853	16905	90671	57147	30893	06623	41475
49234	68411	12338	15153	83208	25784	40268	38287	73891	27376
36185	81850	31507	60906	23892	59827	67797	62799	91022	79253
02697	19279	56989	81942	80964	67913	08399	73386	94867	67321
55830	02431	93205	79197	74599	87585	74438	83704	21945	15137
23957	75773	68884	31936	81490	45020	55818	24592	84987	50474
06343	44395	48564	42993	65735	44594	57843	70724	92870	32617
39485	98566	02373	23953	30520	93264	31347	23349	38934	45635
48876	74880	49887	86365	18299	97041	31641	05984	88948	70140
13551	41581	09044	56419	16195	46709	05714	53352	19679	87224
74692	76567	86266	19132	45849	02131	74225	04155	43997	62830
29131	83732	75242	65232	08872	43279	00809	97046	28851	15337
38528	48380	94012	44693	53843	24203	04579	95053	43817	62309
45021	72055	37371	44018	98373	48304	90618	42059	97379	10602
06474	23471	13782	32396	97506	53770	03116	51076	66798	64104
83575	05580	81439	06635	02816	51003	78830	02038	76344	89083
17007	74305	01821	41041	42674	44803	36700	74785	25617	68049
37606	40561	54302	99589	22671	34258	26432	06732	00600	93367
17936	91024	84985	03289	07721	39729	45809	80821	39587	07684
34330	18439	69577	37771	68254	90970	10173	35598	82336	74141
69074	10171	17991	65383	51863	38535	01224	10097	14548	98917
16723	63250	14038	39436	46531	29073	50638	25920	04575	78448
97324	63679	10177	05637	62994	20462	61271	21702	84168	46679
02085	54343	26238	58376	39827	35866	33987	79586	29719	47766
56224	99229	54362	76943	13980	83508	22616	15862	84824	89884
96214	94020	06341	78763	62643	83854	16712	91383	15935	82958
67058	61329	23706	22885	44251	27633	82942	79253	40230	07629
95044	15713	92819	23532	40332	49307	57167	24892	63015	43145

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88115	59359	88857	19687	34108	33685	47395	85450	74431	53889
28073	71635	12335	70915	34263	46352	13003	75724	91414	70539
32924	78792	18933	91796	63082	95063	10456	61652	81171	64157
79599	42519	05201	17045	39382	85426	78979	45796	77853	37515
67006	80140	74512	12408	64096	48444	88584	30026	86203	69963
53957	07994	42002	12668	50178	10182	60719	91408	52581	31505
49498	88978	17442	68378	54770	03452	35732	66049	71522	78488
18990	45671	72172	37095	63197	35698	27050	80879	22214	17387
56316	57505	67778	56592	42765	46357	21105	62470	27862	30463
90133	09824	25398	50303	93421	45316	67491	08712	49107	89776
53760	25900	43391	18319	08120	63323	15314	18931	06321	67593
24233	68519	57668	89044	21821	50937	98675	93242	03575	52357
11980	81333	87078	85924	87322	71992	37385	89058	03613	58247
72173	21019	66804	98240	86312	94275	65750	39800	89690	79511
55332	13184	41987	81401	08589	19763	15911	62758	90384	08462
57607	25649	41487	81745	25535	45433	38792	67984	14297	03353
69686	81509	19028	75140	03866	82198	64457	32441	90153	47008
34130	16327	81730	80949	11124	64870	04745	32499	40333	61195
85721	82231	09296	43409	80316	68520	05796	57927	49096	43765
40694	73282	88363	23493	66853	05007	88903	89201	38588	74264
28790	73555	39872	82425	67586	04692	58763	73089	62844	07701
01488	66532	81456	26070	54050	21033	34261	62446	04251	88138
95499	75165	80569	89454	25994	26350	81331	66392	22865	38179
23246	93026	49835	68011	46709	97573	41406	87120	23019	76957
54372	71661	98259	03429	90265	78363	79075	69264	01258	25346
50667	67447	12042	93977	84144	57085	92362	17519	44003	00728
39015	09690	22308	55079	46001	52100	62325	34030	86493	05479
30848	98916	84404	69121	62466	64858	20484	41417	70154	54470
03889	22848	43778	74537	75257	60289	91993	33513	47265	92628
94392	05327	45485	23672	49212	40702	27590	45199	41120	28897
68181	66796	01111	81046	03106	02797	46778	06137	74457	17698
54283	10083	48124	66874	40560	20775	77508	24814	42647	61096
48823	58942	76779	11831	71291	30891	75550	08406	35640	97312
24114	27526	36778	52558	03349	27244	32784	31944	04514	79805
58250	09433	49922	73517	05749	29521	11486	35378	02951	19991
53805	24698	90621	44865	30020	79181	27710	77898	18641	25822
67094	32424	78081	01866	06524	15797	50526	19737	46728	47806
96327	08369	01352	81145	76239	27756	92892	40249	12677	20351
96304	17442	26193	50470	40080	45962	27413	52596	74767	15419
14320	29318	35603	67402	11237	10278	34135	11550	08956	78074
17503	66734	92657	25594	48869	45477	07566	01028	98648	11852
78373	76435	19095	11690	87307	86055	69098	79807	32699	21694
78058	96964	06841	98848	17419	09237	80180	37075	15571	75381
74417	70127	90585	33464	32119	49159	97364	98803	41313	52271
05478	71773	34259	73504	17136	90957	04215	79673	59041	58532
95594	70376	56991	94958	73025	72241	18772	83987	66214	96335
86317	76771	66837	10831	54982	29193	64089	48005	22480	35522
71728	32787	76084	68568	38031	65199	70118	82010	63048	89269
39979	10146	27776	94907	33324	37254	91599	06189	53170	95295
15592	60403	42603	96773	89004	87192	57567	05696	98464	98800

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70926	14068	90617	51352	05865	25126	21435	69981	06479	54942
38294	02507	86133	46888	21711	98619	05872	54301	87716	26002
51447	00598	36601	60566	32418	06444	18754	79000	29678	33535
33733	65492	09115	87007	43944	90683	36936	70086	26343	44499
98578	16717	53459	98243	68053	14785	94556	24145	73756	02966
98045	35229	65436	97032	90692	92839	48741	46015	60649	78986
11030	27678	40435	23421	30446	68355	41264	56845	25972	24239
06398	01268	40461	42165	76730	80605	64851	45178	40698	45023
66982	99502	99638	32288	81444	22186	99057	35949	63798	62111
49990	41133	65203	58173	33477	09119	34541	41143	46943	46256
22975	87537	49981	83262	55604	56229	84786	38692	16164	86948
56363	46172	55878	38017	28757	23228	36018	72170	51051	75235
25239	51964	68059	75456	39179	09456	92300	65626	48879	31402
59897	48512	00334	45937	19369	41725	17979	02825	84411	90936
07445	43199	11331	84333	24530	07944	18773	94012	01441	40655
52821	36525	86483	01485	27152	22479	34278	29029	82444	32543
04483	39213	14609	02255	65310	22945	48013	36887	71101	33008
85207	37425	35526	59376	85614	97070	30842	27193	62451	28179
36385	78567	05346	74610	26141	87177	19154	53851	05824	59090
55407	39812	30331	60144	17516	98353	69388	48352	58137	77898
46331	84545	74655	37810	71052	47561	38516	00995	29132	67466
04897	76974	58825	06219	35829	94137	86723	33959	58960	78467
66731	13895	78598	34046	33819	31321	28214	15552	79956	93786
43230	46708	41391	27181	83392	83917	50354	06317	82244	64964
66454	90538	67155	16330	47634	26177	91044	95720	98046	97875
15390	36462	55477	37908	88709	79835	02268	34899	43576	94090
46247	72875	26162	79014	84536	95251	08529	38081	20459	00237
55637	15060	33992	51861	89417	48441	81158	34236	95130	56722
02487	37297	82484	66076	52244	52682	24153	95903	16598	18839
42610	30603	43360	37782	74207	42717	30680	04798	49349	80247
76181	27103	98753	17717	75804	70789	38568	18708	96245	97479
24240	59688	23292	40949	74821	74395	15182	28469	39961	16523
81005	08991	34680	03514	44197	25382	59596	78425	98515	94769
56871	37208	97581	82371	26370	49617	59215	38569	14739	48414
33208	81662	43605	20558	79985	90844	17530	99091	10285	21540
43803	95466	93094	97246	31204	85156	37718	08525	91170	63419
39723	01384	22765	93642	60124	99086	45153	32542	47145	48575
62515	76499	84234	06259	51069	60919	55124	78419	58554	94540
45055	24644	30258	39939	53071	26932	18676	19285	62417	63764
69681	82442	84755	30753	38850	46942	61530	59202	11087	18121
83385	60015	99787	68177	43030	09512	56402	52055	69511	95801
04458	50325	13625	59771	52638	03817	31659	90880	61424	19064
35754	46420	40662	91784	10383	86003	18461	37487	07663	29044
10162	66613	00105	17031	85743	46022	84098	48084	05707	94180
89831	87771	78854	87869	25562	86955	25525	10040	73737	96766
55684	77321	42361	69034	44115	03720	97262	71890	16199	59265
52365	07152	28678	69439	55376	06525	59029	29933	27542	74515
33636	30300	46185	47790	80994	17002	12405	42203	99491	54380
38313	14021	53007	04659	93128	86269	29475	28220	71108	33211
12929	16404	65222	46174	52721	30713	10441	13115	06313	78985

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11767	41715	96921	39440	91713	01252	95477	90091	74570	47814
10209	39469	04395	96949	68306	59930	43058	74922	84796	25716
88035	86619	10325	12403	59223	80176	03721	42071	86811	58308
01488	22623	75963	52672	08033	94360	23673	80897	68904	98109
85453	72323	32385	04738	68076	97592	19285	41760	42244	51078
94870	60073	79608	75998	05122	18855	98943	26426	84879	74388
92793	48899	87556	46924	20939	72246	53768	14024	09495	40912
02048	90603	58746	02696	73115	25929	51870	61184	65085	78295
99402	91657	18017	77315	39059	24381	21328	36197	89852	69923
52804	36184	32274	65204	35397	44192	06055	60314	10940	34627
74967	53533	93594	69969	16216	97183	95154	37719	90074	06928
15360	86221	06240	68606	05993	28257	80451	90422	20624	31777
53092	10820	71341	56926	48072	70936	33884	63004	81011	90241
78293	43707	65260	46559	21593	61172	05802	48592	96801	88425
24698	22898	26339	77971	47433	41759	74193	54506	04385	71026
36341	31972	45946	23649	94999	27633	01609	19345	83854	65117
70032	05924	91583	26358	42395	85283	36548	48571	90295	65056
58505	19927	12491	29716	88554	84748	75150	20811	92332	52934
73594	99247	47006	04316	15214	68184	50502	00906	58323	81340
76445	56970	29913	49346	49418	89565	90371	02911	18781	49995
25906	22504	11638	73444	50364	29434	37229	81270	17091	08384
30906	29090	62259	64926	45247	63145	97190	79048	25472	63993
65174	27188	78410	88819	89691	71654	85623	76958	93888	34121
95707	46159	04585	08264	31148	55333	66354	20732	83733	71859
86800	89098	64605	45971	11658	89650	14679	29076	11295	26756
27050	19535	80967	86429	53087	24524	45176	58099	21062	93277
10321	30484	20157	44523	17221	52332	02171	69984	24729	45615
81688	67931	83947	92274	47572	05921	73696	13267	12007	36060
87754	63269	20414	97007	85234	02765	25037	08013	58209	32893
61003	95084	61292	17324	93461	48671	92398	73811	32577	03895
92634	41808	82881	62269	33586	15206	06382	92818	07525	18506
43023	46101	12756	91289	97832	03007	11112	83193	38078	10928
56571	76602	83541	73035	54212	82112	39610	98224	02571	03610
02277	75958	49212	59055	91260	88372	70664	91292	17350	78812
26333	27670	05556	64366	57386	17327	60852	92021	15754	55988
58163	45678	12771	96906	76195	16623	54681	38763	44930	12599
24866	01275	00882	31104	25970	06468	59772	11493	25244	57906
86997	96175	69773	38015	23916	94438	43706	85667	87188	72475
64237	20191	40654	96516	81157	18779	32641	89064	70199	22278
50601	68108	35854	45951	96090	18262	21094	13284	03783	47529
76183	41550	85252	38048	61986	96431	58408	90223	36116	13558
59038	73354	29214	64984	42285	99793	79106	35548	59039	40442
08430	83898	82979	99138	72201	37238	62822	29049	66756	80217
28493	94724	84455	17948	67633	89500	41013	08398	42274	57451
00322	75838	71501	37001	36824	74950	60632	11372	43392	66804
99942	82603	23184	26296	50994	21524	46967	28332	19674	32822
97872	36870	47178	69926	36075	93302	04530	10172	04809	96867
64219	06580	26192	82666	74607	31539	77593	73076	41422	56992
58098	55623	26057	28619	79776	69449	97532	09986	68865	92882
89624	83227	06730	16023	23771	51774	40547	13335	80053	88160

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99275	48612	21216	65329	47006	81802	25488	71983	53254	49130
93487	83437	17776	85952	25025	36775	48054	51516	34250	80153
77638	96966	33408	52567	97394	44738	82972	74641	10629	27328
13771	86099	85457	58571	84468	13977	68318	67241	81211	50595
82422	08792	07864	18509	17314	57017	41471	01334	83346	52276
79394	17748	90396	44781	82857	73286	98281	05360	64793	89261
15053	36157	18243	03108	81691	95429	61175	63251	51012	30760
30831	20830	21955	49948	55957	13305	47123	90904	83261	63990
61512	40712	24620	52733	44361	69509	14503	27507	11978	53166
52270	08623	15054	40687	92854	34969	25843	05886	23848	37815
69103	56560	84932	19661	06307	56052	78502	97906	53173	20703
73582	54875	08117	98969	71713	04025	91705	35226	26130	20635
91009	80511	72733	51864	93842	41062	34805	54917	58877	06764
57300	92584	28176	93034	51982	67445	81231	35754	08862	16353
92344	93509	93644	67316	55786	46115	81226	81580	56533	28894
92749	83442	68882	04917	60100	60970	89024	26833	22520	14141
42831	12508	45484	77529	12684	74732	97088	83012	10059	29112
07745	53194	02923	61074	63854	76031	53621	82550	48493	04735
45498	56291	87859	53926	31865	91287	32266	51667	11757	85115
09182	74356	98937	05305	44177	41774	56282	83432	18409	59954
66926	27548	13360	74005	81863	47185	45649	98578	33918	26819
29434	65828	22535	71027	81963	89151	85892	46253	32153	62668
42571	68007	13720	72268	36932	83209	50630	86254	99242	84871
44191	51743	00755	11342	96156	70667	92793	64207	00908	20585
74446	78425	06622	18035	10454	00769	82604	23280	31513	80496
01361	80115	72935	17163	22449	53094	44751	89764	63157	10031
12978	51982	49118	56362	57711	86799	99400	99659	94439	72369
61774	37757	07413	39789	32552	79649	50218	18721	43988	44445
38043	01415	45193	84171	52383	92519	94553	32365	46859	74074
15829	42557	52816	20654	41230	92652	20289	18515	59762	77168
65919	70072	05256	51571	82292	43086	03342	00323	34974	27538
42819	32053	60657	82161	35440	03414	06554	36616	95862	14257
23139	91838	52934	54293	84798	35913	01191	24708	34713	37519
19405	64597	82153	40667	49899	84924	49530	56359	42477	08924
07288	45243	60807	81236	70539	14403	92228	85675	29187	93505
69116	89344	12029	01539	93894	65818	59005	07675	24657	68510
63194	11499	17269	88825	33188	65639	63508	66633	68749	38774
45783	92486	36117	48960	28351	14145	10509	87554	58285	72322
07396	88455	49617	31643	59540	77294	84426	31160	54194	05018
89360	23385	55210	93043	02738	29451	16953	50118	05254	65817
73831	35096	11635	69913	59826	49421	30885	99775	94291	39334
52665	80524	66871	10050	20685	15957	17210	61591	80857	13700
65846	39590	21711	76563	70545	01898	13150	61557	28181	68003
53627	91900	09405	76537	98930	77889	57807	75958	91341	58920
70669	44663	26954	84605	51598	23696	28725	09031	66099	05956
62677	12248	24848	02140	01131	56569	13528	24145	45199	09776
83555	56534	67758	71368	26859	95717	28288	18551	30987	20330
83697	77759	52073	04864	55059	94511	15250	26670	78996	64549
44903	84173	97008	84837	53936	01667	37797	55720	19801	69681
49014	65018	85266	95013	10543	74324	00370	44692	12436	62278

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48891	10539	77297	06672	60476	03209	56167	45544	78258	21422
73871	02158	64630	46343	47332	15481	71394	96315	73568	80645
34170	02175	09960	18993	17807	66444	32730	21212	46076	25920
71583	99318	45044	48166	87077	55556	63659	33391	85205	13101
01108	73834	09699	74820	30068	86921	78110	28980	24355	68185
20522	12904	93684	21725	57411	71846	80425	00453	19748	21457
79608	42670	40653	95662	12532	49174	48503	67040	69216	27753
68090	48226	92873	37646	30421	74228	35929	44178	28348	91363
19084	66561	09518	45488	31864	35233	62351	49727	02447	07250
07646	32173	72941	15268	61602	62354	27853	58697	90386	37514
63196	74349	39550	70915	83488	07746	17894	50004	91058	41346
86398	28564	87112	86288	97693	26056	17915	82559	35381	75027
63642	03881	57412	19351	27350	31510	45854	15923	02510	43820
71121	53702	40309	92143	20328	65330	63967	19131	85795	53721
13701	53089	57760	40693	34610	98600	45016	71126	59165	50190
71134	32621	80057	67356	89035	65907	57480	04850	92464	32201
33767	36215	39791	72287	29800	67640	97975	74758	46021	73423
33146	61482	78422	55628	18394	48569	51299	86059	19323	41580
36625	32972	51316	64412	82599	79023	38452	03155	74595	13130
63621	36578	05384	34537	25673	58665	29591	66953	98274	34545
22624	74007	67711	37494	37526	00412	47081	69740	38591	44042
56577	81154	72712	59626	77020	40221	70415	21555	13815	15986
68561	00765	43531	76052	72134	75017	93077	40022	29505	76950
29278	37732	91524	28083	49045	23812	81820	66774	33620	64598
05725	26121	68788	96440	70878	63396	59123	86114	46700	98438
12415	12423	39879	62843	88286	04293	49225	20626	61318	10872
56651	39944	91948	87327	20492	92155	94288	75984	73002	78618
48493	98522	25685	40367	43342	52382	28333	30879	59352	86497
25123	62925	33514	71567	65553	97229	55058	40209	62112	18160
85607	00506	63005	26044	87342	39708	30757	75972	54177	31864
16373	13846	52495	45645	10162	39115	45771	25100	16356	37750
40801	68181	06980	50698	26657	94736	02366	84979	18942	84572
32100	76474	58798	77166	31884	50951	29955	94471	53066	46180
76932	16642	68834	38684	07709	97540	70822	32654	85262	92296
57106	64646	95365	10663	32804	72795	25166	79078	26789	51843
05418	98621	75977	52630	27675	96279	13152	44711	46961	45757
37221	69111	23417	17803	11075	66454	95453	60328	68808	98125
23823	99934	93432	05912	93150	84781	99233	03767	24838	94955
84321	03554	23836	64544	27469	23266	57244	28275	82170	07575
02344	23656	61016	09765	19867	21790	46457	25411	03500	46762
70325	88171	23685	97217	76585	88384	51221	31272	17338	80422
22987	01461	15898	25857	74145	84101	90051	36721	45737	65918
83159	50055	54172	05122	07096	55938	95953	33901	54679	64178
68181	68525	53187	92984	58323	41389	66592	56584	14326	07823
65843	69659	40222	34435	50890	24504	70304	43227	29870	44698
54251	76480	23860	30082	69132	08840	98017	54350	66249	75725
42504	70709	53223	89394	66872	79919	06862	25977	42529	78046
56201	69520	52851	03783	60280	27101	07911	12147	97079	52817
25284	80305	76573	14254	56770	83548	44466	06063	04232	62838
00702	10030	47850	44094	84878	51686	39037	19661	73877	24708

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57045	08074	88727	91303	10880	90387	03049	44649	41682	07161
92889	33197	04117	79760	15336	25030	73686	24054	08666	24607
06135	40078	34575	82871	86196	69883	71312	99329	34122	63290
27526	09658	27405	99448	02380	71414	48311	18536	45957	52546
32443	44984	94521	49020	45683	50812	57968	56310	97631	88709
34091	84585	92750	72213	03810	84047	17607	87085	12607	62564
68190	21907	52999	14903	80020	49368	63721	86548	80086	51686
05191	64586	50535	20491	87132	18487	34210	66368	58881	83704
78088	71769	13917	08311	88957	91965	22411	52575	44377	32138
34271	03646	95035	67881	17645	34452	47064	84451	57918	48975
76667	51400	93187	10311	92693	97380	61008	83243	01776	05137
80232	15879	47748	03011	38553	29224	76115	36026	01249	61250
53017	39124	84777	80739	87900	74156	54184	24003	45929	23730
28699	18974	35297	40752	31285	02656	34584	71261	28462	33431
35394	84361	77346	21801	39236	24825	77081	88028	12544	07565
84813	25422	08800	36063	94441	88637	50780	79144	71908	51899
39900	30333	13938	22799	30507	56296	43120	47179	26489	54531
99174	36078	79599	06223	38520	31678	97203	14143	17457	41301
53762	31370	73669	10523	08875	22489	69203	49879	77277	81867
72787	78482	19585	45029	31822	85128	29960	54344	44851	75381
82163	23362	09644	74123	06831	83252	16929	33737	19381	21302
62357	13766	93851	27009	42621	13612	18873	76885	78819	55665
62350	73856	33253	02353	42231	21028	27646	23292	94705	70722
84764	94194	97699	27029	32935	51595	04454	91100	67131	09041
78327	42124	56300	93706	75936	67290	59600	20201	83979	73231
39284	08465	61364	37573	18285	64619	20079	85596	81849	81686
73507	00339	10678	66490	22653	10032	68648	79622	98925	99635
77675	53001	74015	20232	61900	50260	60094	57780	02739	55069
55144	58892	57952	65272	56004	41356	00190	17413	64296	60680
69545	93269	67239	96561	07443	72133	62418	17791	02994	02665
24029	31914	39122	68971	26865	01521	49285	71212	00822	25330
44665	26518	13219	61450	13321	52526	22629	78390	30087	17735
13196	84012	09819	55245	97721	11900	04586	91248	15214	61259
66401	50382	14549	66579	77859	30100	79010	32512	29816	07127
61962	67996	12828	22706	72646	79669	72214	52460	89227	49089
06771	43014	92202	23860	29456	38047	44988	15786	03658	25037
56042	94875	92991	24042	92395	30212	52225	50280	12944	79124
98428	13542	85663	66158	57744	41097	56298	84834	81051	10048
85814	29832	59007	57398	01033	52085	17512	32395	98564	82408
99657	30745	72197	03217	11839	73768	49206	96954	94375	70130
61069	54986	13341	89688	70977	32056	81627	56776	12859	44176
61108	30705	46984	74866	65173	80340	43903	66334	27757	95664
25672	31476	55896	46337	25418	76725	33877	16903	03276	13106
11136	98716	28020	28414	92289	22989	45797	16935	49843	98385
88537	12364	87867	50446	37446	35919	69387	82296	37350	25132
83003	85363	97045	18857	67214	15043	05498	97716	85302	70414
82128	04345	08532	69206	36560	04641	64006	28763	89057	22560
21388	13394	80549	87537	11673	98421	34723	30630	67516	99516
29672	42547	26085	15173	44457	13154	98748	31213	87025	16793
65120	17193	77381	48198	72074	08512	43387	27964	86082	57332

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14541	36678	54343	94932	25238	84928	30668	34992	69955	06633
88626	98899	01337	48085	83315	33563	78656	99440	55584	54178
31466	87268	62975	19310	28192	06654	06720	64938	67111	55091
52738	52893	51373	43430	95885	93795	20129	54847	68674	21040
17444	35560	35348	75467	26026	89118	51810	06389	02391	96061
62596	56854	76099	38469	26285	86175	65468	32354	02675	24070
38338	83917	50232	29164	07461	25385	84838	07405	38303	55635
29163	61006	98106	47538	99122	36242	90365	15581	89597	03327
59049	95306	31227	75288	10122	92687	99971	97105	37597	91673
67447	52922	58657	67601	96148	97263	39110	95111	04682	64873
57082	55108	26992	19196	08044	57300	75095	84330	92314	11370
00179	04358	95645	91751	56618	73782	38575	17401	38686	98435
65420	87257	44374	54312	94692	81776	24422	99198	51432	63943
52450	75445	40002	69727	29775	32572	79980	67902	97260	21050
82767	26273	02192	88536	08191	91750	46993	02245	38659	28026
17066	64286	35972	32550	82167	53177	32396	34014	20993	03031
86168	32643	23668	92038	03096	51029	09693	45454	89854	70103
33632	69631	70537	06464	83543	48297	67693	63137	62675	56572
77915	56481	43065	24231	43011	40505	90386	13870	84603	73101
90000	92887	92668	93521	44072	01785	27003	01851	40232	25842
55809	70237	10368	58664	39521	11137	20461	53081	07150	11832
50948	64026	03350	03153	75913	72651	28651	94299	67706	92507
27138	59012	27872	90522	69791	85482	80337	12252	83388	48909
03534	58643	75913	63557	25527	47131	72295	55801	44847	48019
48895	34733	58057	00195	79496	93453	07813	66038	55245	43168
57585	23710	77321	70662	82884	80132	42281	17032	96737	93284
95913	24669	42050	92757	68677	75567	99777	49246	93049	79863
12981	37145	95773	92475	43700	85253	33214	87656	13295	09721
62349	64163	57369	65773	86217	00135	33762	72398	16343	02263
68193	37564	56257	50030	53951	84887	34590	22038	40629	29562
56203	82226	83294	60361	29924	09353	87021	08149	11167	81744
31945	23224	08211	02562	20299	85836	94714	50278	99818	62489
68726	52274	59535	80873	35423	05166	06911	25916	90728	20431
79557	25747	55585	93461	44360	18359	20493	54287	43693	88568
05764	29803	01819	51972	91641	03524	18381	65427	11394	37447
30187	66931	01972	48438	90716	21847	35114	91839	26913	68893
30858	43646	96984	80412	91973	81339	05548	49812	40775	14263
85117	38268	18921	29519	33359	80642	95362	22133	40322	37826
59422	12752	56798	31954	19859	32451	04433	62116	14899	38825
73479	91833	91122	45524	73871	77931	67822	95602	23325	37718
83648	66882	15327	89748	76685	76282	98624	71547	49089	33105
19454	91265	09051	94410	06418	34484	37929	61070	62346	79970
49327	97807	61390	08005	71795	49290	52285	82119	59348	55986
54482	51025	12382	35719	66721	84890	38106	44136	95164	92935
30487	19459	25693	09427	10967	36164	33893	07087	16141	12734
42998	68627	66295	59360	44041	76909	56321	12978	31304	97444
03668	61096	26292	79688	05625	52198	74844	69815	76591	35398
45074	91457	28311	56499	60403	13658	81838	54729	12365	24082
58444	99255	14960	02275	37925	03852	81235	91628	72136	53070
82912	91185	89612	02362	93360	20158	24796	38284	55328	96041

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44553	29642	20317	69470	57789	27631	68040	73201	51302	66497
01914	36106	71351	69176	53353	57353	42430	68050	47862	61922
00768	37958	69915	17709	31629	49587	07136	42959	56207	03625
29742	67676	62608	54215	97167	07008	77130	15806	53081	14297
07721	20143	56131	56112	23451	48773	38121	74419	11696	42614
99158	07133	04325	43936	83619	77182	55459	28808	38034	01054
97168	13859	78155	55361	04871	78433	58538	78437	14058	79510
07508	63835	83056	74942	70117	91928	10383	93793	31015	60839
68400	66460	67212	28690	66913	90798	71714	07698	31581	31086
88512	62908	65455	64015	00821	23970	58118	93174	02201	16771
94549	31145	62897	91582	94064	14687	47570	83714	45928	32685
02307	86181	44897	60884	68072	77693	83413	61680	55872	12111
28922	89390	66771	39185	04266	55216	91537	36500	48154	04517
73898	85742	97914	74170	10383	16366	37404	73282	20524	85004
66220	81596	18533	84825	43509	16009	00830	13177	54961	31140
64452	91627	21897	31830	62051	00760	43702	22305	79009	15065
26748	19441	87908	06086	62879	99865	50739	98540	54002	98337
61328	52330	17850	53204	29955	48425	84694	11280	70661	27303
89134	85791	73207	93578	62563	37205	97667	61453	01067	31982
91365	23327	81658	56441	01480	09677	86053	11505	30898	82143
54576	02572	60501	98257	40475	81401	31624	27951	60172	21382
39870	60476	02934	39857	06430	59325	84345	62302	98616	13452
82288	29758	35692	21268	35101	77554	35201	22795	84532	29927
57404	93848	87288	30246	34990	50575	49485	60474	17377	46550
22043	17104	49653	79082	45099	24889	04829	49097	58065	23492
61981	00340	43594	22386	41782	94104	08867	68590	61716	36120
96056	16227	74598	28155	23304	66923	07918	15303	44988	79076
64013	74715	31525	62676	75435	93055	37086	52737	89455	83016
59515	37354	55422	79471	23150	79170	74043	49340	61320	50390
38534	33169	40448	21683	82153	23411	53057	26069	86906	49708
41422	50502	40570	59748	59499	70322	62416	71408	06429	70123
38633	80107	10241	30880	13914	09228	68929	06438	17749	81149
48214	75994	31689	25257	28641	14854	72571	78189	35508	26381
54799	37862	06714	55885	07481	16966	04797	57846	69080	49631
25848	27142	63477	33416	60961	19781	65457	23981	90348	24499
27576	47298	47163	69614	29372	24859	62090	81667	50635	08295
52970	93916	81350	81057	16962	56039	27739	59574	79617	45698
69516	87573	13313	69388	32020	66294	99126	50474	04258	03084
94504	41733	55936	77595	55959	90727	61367	83645	80997	62103
67935	14568	27992	09784	81917	79303	08616	83509	64932	34764
63345	09579	40232	51061	09455	36491	04810	06040	78959	41435
87119	21605	86917	97715	91250	79587	80967	39872	52512	78444
02612	97319	10487	68923	58607	38261	67119	36351	48521	69965
69860	16526	41420	01514	46902	03399	12286	52467	80387	10561
27669	67730	53932	38578	25746	00025	98917	18790	51091	24920
59705	91472	01302	33123	35274	88433	55491	27609	02824	05245
36508	74042	44014	36243	12724	06092	23742	90436	33419	12301
13612	24554	73326	61445	77198	43360	62006	31038	54756	88137
82893	11961	19656	71181	63201	44946	14169	72755	47883	24119
97914	61228	42903	71187	54964	14945	20809	33937	13257	66387

APPENDIX H. CALCULATION OF THE AVERAGE RANGE

To calculate the average range of package errors for groups of 5 packages:

1. Record the package errors in successive groups of five packages in the order of weighing. (See Figure 2-5, page 2-19, and page A-1.)

   For example, the following package errors were recorded on the report form (only the first three columns are shown):

pkg. number	pkg. error	pkg. number	pkg. error	pkg. number	pkg. error
(1)	+2	(6)	-2	(11)	+2
(2)	+4	(7)	-4	(12)	-4
(3)	+5	(8)	-5	(13)	+5
(4)	+10	(9)	-10	(14)	+10
(5)	+3	(10)	-3	(15)	-3

2. Calculate the range (R) of package errors for each group of five. R does not have a sign.

   The range is obtained as follows:

   - o If there are only plus errors in a group of five, subtract the smallest plus error from the largest plus error. This is the range (R) for the group.

     For example for the first group of five packages:

     +2
     +4
     +5
     +10
     +3
     R = +10 - (+2) = 8

   - o If there are only minus errors in the group, subtract the largest number with a minus sign from the smallest number with a minus sign. This is the range (R) for the group.

     For example for the second group of five packages:

     -2
     -4
     -5
     -10
     -3
     R = -2 - (-10) = 8

- If there are both plus and minus errors in the group of five, add the largest error which has a plus sign to the largest error which has a minus sign (but ignore the minus sign). This is the range (R) of the group.

  For example for the third group of five packages:

  +2
  -4
  +5
  +10
  -3
  R = +10 + 4 = 14

3. Calculate the sum of all R and note the number of groups. For example, let us consider the previous three examples as one set of sample data. For these examples the sum of R = 8 + 8 + 14 = 30 and the number of groups is 3.

4. Calculate the average R, called R, as follows:

$$R = \frac{\text{sum of all R (step 3)}}{\text{number of groups}}$$

In the example above, $R = \frac{30}{3} = 10$

When calculating the range in net weights or range in tare weights for the alternative tare procedure, the range is the difference between the largest and smallest weights.

For example, the following tare weights are recorded:

0.201 lb
0.200 lb
0.204 lb
0.199 lb
0.201 lb

The range in tare weights is 0.204 lb - 0.199 lb = 0.005 lb.

APPENDIX I. EQUIPMENT TOLERANCES

Table I-1. Tolerances for field standard weights (avoirdupois and metric).[a]

CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Avoirdupois)

Tolerances for weights 2 lb or larger are 1 part in 10,000; weights between 0.5 lb and 0.02 lb are 1 part in 5,000; weights smaller than 0.02 lb have tolerances determined by the equation in footnote c. For all denominations not shown, but which are intermediate between those listed, the tolerance for the smaller denomination shall apply.

Denomination	Tolerances	
Pounds (lb)	Pounds (lb)	Grams (g)
10,000	1.00	454
5,000	0.50	227
3,000	0.30	136
2,500	0.25	113
2,000	0.20	90.5
1,000	0.10	45.5
500	0.05	22.5
100	0.010	4.5
50	0.005	2.3
30	0.003	1.4
20	0.002	0.91
10	0.001	0.45
	Micropounds (μlb)[b]	Milligrams (mg)
5	500	227
3	300	136
2	200	91
1	154	70
0.5	100	45
0.3	60	27
0.2	40	18
0.1	20	9.1
0.05	10	4.5
0.03	6	2.7
0.02[c]	4	1.8
0.01	3.20	1.45
0.005	2.58	1.17
0.003	2.18	0.99
0.002	1.92	0.87
0.001	1.54	0.70
Ounces (oz)	Micropounds (μlb)[b]	Milligrams (mg)
8	100	45
4	50	23
2	25	11
1	12	5.4
(1/2) 0.5	6.2	2.8
0.3[c]	3.92	1.78
(1/4) 0.25	3.70	1.68
0.2	3.44	1.56
(1/8) 0.125	2.96	1.34

CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Metric)

Tolerances for weights 1 kg or larger are 1 part in 10,000; weights between 300 g and 10 g are 1 part in 5,000; weights smaller than 10 g have tolerances determined by the equation in footnote c. For all denominations not shown, but which are intermediate between those listed, the tolerance for the smaller denomination shall apply.

Denomination	Tolerances
Kilograms (kg)	Grams (g)
500	50.0
300	30.0
200	20.0
100	10.0
50	5.00
30	3.00
20	2.00
10	1.00
	Milligrams (mg)
5	500
3	300
2	200
1	100
Grams (g)	
500	70
300	60
200	40
100	20
50	10
30	6
20	4
10[c]	2
5	1.50
3	1.28
2	1.12
1	0.90
Milligrams (mg)	
500	0.72
300	0.61
200	0.54
100	0.43
50	0.35
30	0.29
20	0.26
10	0.21
5	0.17
3	0.14
2	0.12
1	0.10

Table I-1. Tolerances for field standard weights (avoirdupois and metric) (Continued).

Denomination	Tolerances	
Ounces (oz)	Micropounds	Milligrams (mg)
	(μlb)[b]	
0.1	2.76	1.25
(1/16) 0.0625	2.38	1.08
0.05	2.20	1.00
(1/32) 0.03125	1.90	0.86
0.03	1.87	0.85
0.02	1.65	0.75
0.01	1.32	0.60

[a] NBS Handbook 105-1, Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures. 1. Specifications and Tolerances for Field Standard Weights and Measures, in preparation.

[b] 1 μlb = 0.000001 lb

[c] The following equation for tolerances for weights smaller than 10 g is designed to be used only with metric units. Avoirdupois values must be converted.

$T(w) = 0.9\ w^{0.318}$ where $T(w)$ is the tolerance in milligrams and w is the metric equivalent in grams of the nominal weight for which the tolerance is being determined.

Table I-2. Scale units and tolerances for field standard flasks and cylinders (inch-pound and metric fluid measures)[a]

Scale units for flasks in inch-pound fluid measure

Size	Graduated range on each side of nominal	Minimum graduation
Gill	1/2 fl dr	1/4 fl dr
1/2 Pint	1 fl dr	1/4 fl dr
Pint	2 fl dr	1/2 fl dr
Quart	4 fl dr	1 fl dr
1/2 Gallon	6 fl dr	1 fl dr
Gallon	8 fl dr	1 fl dr

Tolerances for inch-pound field standard flasks and cylinders (with conversions to milliliters)

Nominal capacity at 68 °F	Tolerances at nominal capacity	Tolerances at total or partial capacity (i.e. graduated portion)
1 Gill 1 920 Minims (118.3 mL)	3 Minims (0.18 mL)	1.0 Minims (0.06 mL)
1/2 Pint 3 840 Minims (236.6 mL)	4 Minims (0.25 mL)	1.5 Minims (0.09 mL)
1 Pint 7 680 Minims (473.2 mL)	7 Minims (0.43 mL)	3.0 Minims (0.18 mL)
1 Quart 15 360 Minims (946.3 mL)	12 Minims (0.74 mL)	5.0 Minims (0.31 mL)
1/2 Gallon 30 720 Minims (1 892.7 mL)	16 Minims (0.99 mL)	5.0 Minims (0.31 mL)
1 Gallon 61 440 Minims (3 785.4 mL)	20 Minims (1.23 mL)	5.0 Minims (0.31 mL)
2 Fluid Ounce Cylinder 960 Minims (59.1 mL)	5 Minims (0.31 mL)	5.0 Minims (0.31 mL)

Scale units for metric flasks

Size	Graduated range on each side of nominal	Minimum graduation
100 mL	2 mL	0.5 mL
200 mL	4 mL	0.5 mL
250 mL	4 mL	0.5 mL
500 mL	8 mL	0.5 mL
1000 mL	15 mL	1.0 mL
2000 mL	25 mL	1.0 mL

Tolerances for metric field standard flasks and cylinders

Capacity	Tolerance at nominal capacity	Tolerance at total or partial capacity (i.e. graduated portion)
10 mL[b]	---	---
100 mL	0.2 mL	0.08 mL
200 mL	0.3 mL	0.10 mL
500 mL	0.3 mL	0.10 mL
1000 mL	0.5 mL	0.20 mL
2000 mL	1.0 mL	0.30 mL
50 mL cylinder	0.3 mL	0.30 mL

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[a] NBS Handbook 105-2, Specifications and Tolerances for Reference Standard and Field Standard Weights and Measures. 2. Specifications and Tolerances for Field Standard Measuring Flask, revision in preparation.

[b] Tolerance of 10 mL graduate is 0.08 mL calibrated "to contain" and 0.10 mL calibrated "to deliver".

APPENDIX J. EXCERPT FROM THE USDA MEAT AND POULTRY INSPECTION MANUAL

NET WEIGHT

Subpart 18-K

(Regs: M-317; P-Subpart N)

Net weights must be accurate. Systematic plant controls must be maintained over container contents to comply with regulations.

18.61 NET WEIGHT

(a) Definition

Net weight includes all nutritious contents suitable for food. It is the gross weight minus the tare weight.

When meat or poultry product is packed in nonnutritious medium--water, brine, agar--the net weight is the drained weight.

(b) Determination

Net weight may be determined by approved quality control system or lot inspection.

(1) Approved quality control.

(i) Inspector. When a plant quality control system, approved by STS-SDS is in effect (Subpart 18-A), the inspector shall:

1. Assure that approved procedure is on file in the Government office. Such procedure includes sampling rates, limits, and actions to be taken when limits are exceeded.

2. Observe plant sampling, weighing, and recording of random intervals at least five times a week.

Subpart 18-K, "Net Weight", pp. 168-174, from combined changes through December 1981, U.S. Department of Agriculture, Food Safety and Inspection Service, Meat and Poultry Inspection Program.

3. Review charts and keep a log of observations in the Government office.
4. Sample one subgroup at least twice a week. Weigh and record as required of the plant. Use alternate scales and check for accuracy. Keep a log of results on file in the Government office.
5. Assure that (1) he is notified when prescribed limits are exceeded, (2) plant personnel take corrective action, and (3) sampling and recording data are accurate.
6. Check a lot by the lot inspection procedure at least once a week, and keep record.
7. Adhere to general requirements in Subpart 18-A.

(ii) Plant. Plant's quality control personnel shall:

1. Maintain records of net weights taken during filling operations. Each individual weight will be recorded as well as the time, filling line, product, code and any other necessary identifying information. Also the target weight, required weight, and limits for individual and subgroup averages must be shown. Displaying weights graphically on control charts has been shown to be effective in clearly reflecting trends and predicting eventual lot acceptability.
2. Check net weights in groups of 5 or 10 containers at a time. Record all weights on the chart even if product is reworked immediately. Check at least one group an hour. This should be increased to maintain a rate of at least one group per 2,000 containers but need not exceed three per hour.
3. Total the weights in each group and determine the average (X) and the range (R).
4. Plot the lowest and the average value as well as the range. On the chart indicate action taken whenever underweights exceed limits in Table 18.14.
5. Take the following action when such limits are exceeded:

a. Try to ascertain the cause when an individual weight falls below the "Lower Limit for Individual Weights (LRL)." If an assignable cause is found, correct the fault immediately. If no cause is found, increased sampling must be instituted and maintained for a reasonable period of time before concluding that the low individual weight was an accident. Notify the Government inspector who may require retention and sorting if this occurs more than once in 40 subgroups on any one production line.

b. If a group average falls below the "Lower Limit for Subgroup Averages $(LRL_{\bar{X}})_{10}$ or $(LRL_{\bar{X}})_{5}$," take the same action as outlined in "a" for low individual weights.

c. If a series of group averages below the label weight equals or exceeds the run criteria listed in Table 18.15 segregate all production back to the last group weighed before the run. Notify the inspector who will retain this portion because of low average net weight.

d. Retain the entire shift's production if the average of all subgroups weighed during the shift is less than the stated label weight. (Exclude from this average all subgroups representing portions of production rejected during the shift for failure to meet the run criteria). Notify the inspector who will retain the production because of low net weights.

e. Notify production personnel whenever the range equals or exceeds the "Range Limits $(R)_{10}$ or $(R)_{5}$." They should search for assignable causes (such as a malfunctioning filling machine) and make necessary adjustments.

6. Contact STS-SDS with requests for permission to use limits more liberal than those in Table 18.14.

(2) Lot Inspection. For all import inspections and when an approved plant

Part 18

Table 18.14 - Minimum and maximum limits 1/ for QC inspection

Standard deviation			.08 oz.	.16 oz.	.33 oz.	.50 oz.
$\bar{X}'$ = Marked or required net weight		Group A	Group 1	Group 2	Group 3	Group 4
Lower limit for individual weights (LRL)	$\bar{X}'$ Minus	10% of $\bar{X}'$	7.1 gm.	14.2 gm.	28.3 gm.	42.5 gm.
			.25 oz.	.50 oz.	1 oz.	1.50 oz.
			8/32 oz.	16/32 oz.	1 oz.	1 16/32 oz.
			4/16 oz.	8/16 oz.	1 oz.	1 8/16 oz.
			2/10 oz.	5/10 oz.	1 oz.	1 5/10 oz.
			2/8 oz.	4/8 oz.	1 oz.	1 4/8 oz.
			1/4 oz.	2/4 oz.	1 oz.	1 2/4 oz.
Lower limit for subgroup averages of 10 weights (LRL-) X 10	$\bar{X}'$ Minus	3% of $\bar{X}'$	2.2 gm.	4.5 gm.	9.1 gm.	13.6 gm.
			0.08 oz.	.16 oz.	.32 oz.	.48 oz.
			2/32 oz.	5/32 oz.	10/32 oz.	15/32 oz.
			1/16 oz.	2/16 oz.	5/16 oz.	7/16 oz.
			(2/)	1/10 oz.	3/10 oz.	4/10 oz.
			(2/)	1/8 oz.	2/8 oz.	3/8 oz.
			(2/)	(2/)	1/4 oz.	1/4 oz.
Lower limit for subgroup averages of 5 weights (LRL-) X 5	$\bar{X}'$ Minus	4% of $\bar{X}'$	3.5 gm.	7.0 gm.	14.1 gm.	21.2 gm.
			.12 oz.	.25 oz.	.50 oz.	.75 oz.
			4/32 oz.	8/32 oz.	16/32 oz.	24/32 oz.
			2/16 oz.	4/16 oz.	8/16 oz.	12/16 oz.
			1/10 oz.	2/10 oz.	5/10 oz.	7/10 oz.
			1/8 oz.	2/8 oz.	4/8 oz.	6/8 oz.
			(2/)	1/4 oz.	2/4 oz.	3/4 oz.
Limit for ranges of subgroups of 10 weights $(R)_{10}$		15% of $\bar{X}'$	10.8 gm.	21.5 gm.	43.4 gm.	64.9 gm.
			.38 oz.	.76 oz.	1.53 oz.	2.29 oz.
			12/32 oz.	24/32 oz.	1 17/32 oz.	2 9/32 oz.
			6/16 oz.	12/16 oz.	1 8/16 oz.	2 4/16 oz.
			3/10 oz.	7/10 oz.	1 5/10 oz.	2 2/10 oz.
			3/8 oz.	6/8 oz.	1 4/8 oz.	2 2/8 oz.
			1/4 oz.	3/4 oz.	1 2/4 oz.	2 1/4 oz.
Limit for ranges of subgroups of 5 weights $(R)_5$		12% of $\bar{X}'$	9.1 gm.	18.4 gm.	36.8 gm.	55.0 gm.
			.32 oz.	.65 oz.	1.30 oz.	1.94 oz.
			10/32 oz.	20/32 oz.	1 9/32 oz.	1 30/32 oz.
			5/16 oz.	10/16 oz.	1 4/16 oz.	1 15/16 oz.
			3/10 oz.	6/10 oz.	1 3/10 oz.	1 9/10 oz.
			2/8 oz.	5/8 oz.	1 2/8 oz.	1 7/8 oz.
			1/4 oz.	2/4 oz.	1 1/4 oz.	1 3/4 oz.

1/ Use limits recorded in terms of scale calibrations used. Ex: If scale is in 1/16ths, use limits in 1/16ths; if in grams use gram limits. Do not convert.

2/ Minimum limit is the marked or required net weight when sensitivity of scales used does not permit calibrations as precise as those recorded above.

Table 18.15 - Run criteria 1/

	Consecutive subgroup averages					
Number of consecutive subgroup averages plotted on control chart	7	11	14	17	20	23
This number of subgroup averages below stated label weight is excessive	7	10	12	14	16	18

1/ Action should be taken when four consecutive low subgroup averages occur. Frequent runs over four low averages indicate an ineffective control program; it would be cause for approval withdrawal and return to lot inspection.

quality control system does not exist, the inspector shall determine net weight compliance by the following procedure.

1. Check a total of 10 lots each week. This should be increased if frequency of underweight lots warrants, or should be decreased if volume of production is low. Emphasis should be placed on those items which are frequently borderline or low in weight.

Groups. For purpose of assigning individual and average weight limits, all products are placed into one of five groups as shown in Table 18.16. Homogeneous products are those which are of uniform consistency throughout. Baby food is homogeneous; beef stew is not. "Fluid" at time of filling refers to liquids and solid products (like shortening) which are heated and filled as a liquid.

Table 18.16 - Groups

Group	Definitions	
	Homogenous fluid when filled (Ounces)	All other products (Ounces)
A	Less than 3	Less than 3
1	3 to 16	
2	Over 16	3 to 7
3		Over 7 to 48
4		Over 48 to 160
5		Over 160

Scales. Any accurate scale may be used, although tolerances are generally more liberal when scales with greater sensitivity are used. Scales should be set on a solid foundation and periodically checked with weights of known accuracy. In reading a scale, should the pointer fall between two subdivisions, the weight should always be read as the lower calibration. Never round off to the higher calibration.

2. Determine the average tare weight. The total weight of all containers weighed divided by the number weighed is the average tare weight.

a. Sources of Containers.

The individual empty containers which were or will be weighed to obtain individual gross weights.

Any other samples of empty containers from the lot before or after filling.

Different lots of containers of the same type, style, size and manufacture (provided past experience shows less than one-eight ounce variation in average tare weights between lots).

b. Determination of Tare Weight.

If prior to filling empty containers and lids from the same source are

Table 18.17 - Tare weights

Range of first 3 container tare weights (ounces)	Total number of container [1/] tare weights required (include first 3)
0 to 1/8	3
3/16	6
1/4	9
5/16	12
3/8 or more	15

[1/] If unfilled containers are not available and total number needed for tare weights exceeds the number opened for product examination, use only number opened. In this case, maintain a history of succeeding lots of same cans until a proper average tare is obtained (at least 15 samples).

available, weigh a minimum of 15 containers. Use the average weight of the 15 as the tare weight.

When unfilled containers are not available, empty, wash, dry and weigh three containers from the lot. Use the same scale as that used for net weight determination or one of greater sensitivity.

Determine the range of container weights. The total number of empty containers weighed to establish the average tare weight for a lot will be based on the difference between the highest and lowest of these first three weights as indicated in Table 18.17.

3. Select samples from the completed lot or if the size of the lot to be packed can be predicted, samples may be randomly selected during the packing operation. Under no circumstances are weights to be determined until after the lot is completed. Check weights are strictly plant's function during production.

4. Determine the individual net weights on an initial sample of 10 clean, dried, filled containers randomly selected from the lot. Record them on Form MP 486. File this form in the inspector's office for one year.

5. Calculate the average net weight by adding the 10 individual weights and dividing by 10. This average should always be expressed in the same denomination as the scale calibration. If the scale is calibrated in 16ths of an ounce, the average weight should be expressed in ounces rounded off to the nearest 16th. (for example, if we had 10 weights which averaged 8 $\frac{.67}{16}$ oz., we would round it off to 1/16 and express the average for the lot as 8 1/16 oz.).

6. For Groups A and 1 through 4, determine:

a. The two lowest individual net weights, and

b. The plus or minus difference between the declared label weight and the sample average.

7. Select the proper group for underweight limits from Table 18.16.

8. Use the limits prescribed in Table 18.18 for the proper group. Select those that are listed in the same calibration as the scale being used.

9. Accept the lot without further sampling if

a. Neither of the 2 lowest individual weights is less than the appropriate "Lower Limit for Individual Weights (L)," in Table 18.18.

Table 18.18 - Minimum and maximum limits 1/ for lot inspection

$\bar{X}$ = Marked or required net weight		Group A	Group 1	Group 2	Group 3	Group 4
Lower limit for individual weights (L)	$\bar{X}'$ Minus	10% of $\bar{X}'$	7.1 gm. 0.25 oz. 8/32 oz. 4/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.	14.2 gm. .50 oz. 16/32 oz. 8/16 oz. 5/10 oz. 4/8 oz. 2/4 oz.	28.3 gm. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz.	42.5 gm. 1.50 oz. 1 16/32 oz. 1 8/16 oz. 1 5/10 oz. 1 4/8 oz. 1 2/4 oz.
Lower limit for averages of first 10 weights (A_1)	$\bar{X}'$ Minus	3% of $\bar{X}'$	2.2 gm. .08 oz. 2/32 oz. 1/16 oz. (2/) (2/) (2/)	4.5 gm. .16 oz. 5/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. (2/)	9.1 gm. .32 oz. 10/32 oz. 5/16 oz. 3/10 oz. 2/8 oz. 1/4 oz.	13.6 gm. .48 oz. 15/32 oz. 7/16 oz. 4/10 oz. 3/8 oz. 1/4 oz.
High value for averages of first 10 weights (A_2)	$\bar{X}'$ Plus	3% of $\bar{X}'$	2.2 gm. .08 oz. 3/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. 1/4 oz.	4.5 gm. .16 oz. 6/32 oz. 3/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.	9.1 gm. 0.32 oz. 11/32 oz. 6/16 oz. 4/10 oz. 3/8 oz. 2/4 oz.	13.6 gm. .48 oz. 16/32 oz. 8/16 oz. 5/10 oz. 4/8 oz. 2/4 oz.
Limit for low averages of 40 for permitting additional weights (when requested)	$\bar{X}'$ Minus	1% of $\bar{X}'$	1.1 gm. 0.04 oz. 1/32 oz. (2/) (2/) (2/) (2/)	2.3 gm. 0.08 oz. 2/32 oz. 1/16 oz. (2/) (2/) (2/)	4.5 gm. 0.16 oz. 5/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. (2/)	7.0 gm. .25 oz. 8/32 oz. 4/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.

1/ Use limits recorded in terms of scale calibrations used. Ex.: If scale is in 1/16ths, use limits in 1/16ths; if in grams, use gram limits. Do not convert.

2/ Minimum limit is the marked or required net weight when sensitivity of scales used does not permit calibrations as precise as those recorded above.

b. The sample average equals or exceeds the appropriate "High Value for Averages (A_2)," Table 18.18.

10. Retain the lot without further sampling if

a. The 2 lowest weights are both less than the appropriate "Lower Limit for Individual Weights (L)," or

b. The sample average is less than the appropriate "Lower Limit for Averages (A_1)," Table 18.18.

11. Weigh an additional 30 filled containers randomly selected from the lot if:

a. One of the 2 lowest of the first 10 weights is less than the appropriate "Lower limit for the Individual Weights (L)," or

b. The sample average of the first 10 weights is less than "High Value for Averages (A_2)," but not less than the "Lower Limit for Averages (A_1)."

Table 18.19 - Basic average ranges for groups A and 1 thru 4

Group A (Ounces)	Group 1 (Ounces)	Group 2 (Ounces)	Group 3 (Ounces)	Group 4 (Ounces)
Less than .15	.15-25	Over .25-.50	Over .50-1.0	Over 1.0-1.5

12. If an extra 30 weights are needed, calculate the average net weight by dividing the total of all 40 weights by 40. Then note:

a. The two lowest of the 40 individual net weights, and

b. The plus or minus difference between the sample average and the label weight.

c. Accept lot if (1) not more than 1 of 2 lowest of the 40 weights is less than the appropriate "Lower Limit for Individual Weights (L)," and (2) the average of the 40 weights equals or exceeds the label weight.

d. Retain the lot if (1) both of two lowest of the 40 weights is less than the appropriate "Lower Limit for Individual Weights (L)," or (2) the average of the 40 weights is less than the label weight. If the average underweight does not exceed the appropriate Limit for Averages of 40 in Table 18.18, an additional 40 weights may be taken, if requested, to verify the results. All 80 weights should then be averaged and the criteria for a sample of 40 applied. Accept the lot only if average equals full label weight and not more than one sample is lower than (L).

e. If continued sampling of a particular product in an establishment results in frequent samplings of additional 30 containers, check to see if the ranges of the first 10 weights have been generally within the "Basic Average Range" for a lower group in Table 18.19. If so, limits for this lower group may then be used.

13. For all products in Group 5 (either catch weighed or in preprinted packages), weigh 10 sample units and accept the lot, if

a. Acceptable variations between actual weights and labeled weights. (1) For scales calibrated in 1/4 pound graduations or more no label net weight exceeds the actual weight by more than one scale graduation. E.g. scale marked in 1/4 pounds. Acceptable - marked weight 15 1/4 pounds, actual weight 15 pounds. Unacceptable - marked weight 15 1/4 pounds, actual weight 14 3/4 pounds, or (2) for scales calibrated in less than 1/4 pound graduations no label net weight exceeds the actual weight by more than two ounces. E.g. scale marked in 1/2 ounce. Acceptable - marked weight 15 pounds 3 ounces, actual weight 15 pounds 1 ounce. Unacceptable - marked weight 15 pounds 3 ounces, actual weight 15 pounds 3/4 ounce, and

b. The inspector must read and record net weights as outlined in paragraph (b) (2) under scales. The total net weight of the 10 sample units equals or exceeds the total marked weight of the 10 sample units.

c. Product not meeting the above criteria is rejected. If domestic, it may be reweighed and remarked.

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The second edition of NBS Handbook 133, like the first edition, is a procedural manual for compliance testing of the net contents statements on packaged goods. Packaged goods may be labeled by weight, volume, length, area, or count. Two categories of sampling plans are provided for packages subject to the average requirement. Other sampling plans are provided for special products. Test procedures are provided in detail for a wide variety of products. The manual contains information on equipment, test methods, calculations, and test reporting.

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